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A Study of Lesions of the hands and feet in connection with the presence of Ringworm fungi and other Fungi or Yeast infections.

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In looking over dermatological literature of the last 8 years, more especially American, one cannot help being struck by the increasing number of articles on and references to mycotic infections of the hands and feet.

Gathered from this Literature was the fact that by careful examination an increasing number of these lesions, previously diagnosed as dermatitis, eczema, cheiro pompholyx , of unknown etiology were really due to a fungus infection.

The examination of a few cases with positive results suggested a systematic examination of the large number of cases, from a very thickly populated industrial area, presenting themselves with suggestive lesions. Actually more cases were seen than could be dealt with owing to pressure of other work. No previous systematic examination having been made in this area, it was felt that a useful purpose would be served in showing the prevalence of mycotic infections and types of fungi here for comparison with other countries, and in an attempt to further the rescue of hand and foot lesions from the designation "of unknown origin".

The Literature.

Hebra was the first to call attention to the presence of ringworm of the body apart from the scalp in his paper on Eczema marginatum in 1860, when he pointed out that the condition might also occur on the extremities. For a considerable period afterwards attention was only paid to the disease in the groins.

Next to mention the condition was Tilbury Fox in the British Medical Journal in 1870, where he discussed ringworm on a hand.

In 1888 Pellizari (1) described seven cases occurring on the hands and feet in association with Tinea capitis. In 1892 D[illegible] Moukhtar (2) made the first careful and systematic study of ringworm infections of the hands and feet and described 25 cases during the year. He was the first to point out the hyperkeratotic type of the infections occurring usually on the soles but occasionally on the palms, and also was the first to note that Cheiro pompholyx and ringworm were indistinguishable clinically.

Next in 1908 Whitfield (3), in the Lancet, published an account of five cases of vesico-squamous eczema of the hands and feet containing fungi. These were discovered in the routine examination of scales and vesicles which he made in all his cases.

Sabouraud (4) in 1910 made a resume of the subject of Eczema marginatum and described seven cases as affecting the hands and feet. He for the first time pointed out that these lesions were caused by the same fungus as occurs in the groin infections - the Epidermophyton inguinale as he named it.

In February 1911, Whitfield (5) described seven more cases and mentioned the use of the ointment which bears his name.

The papers by Whitfield (6) and Sabouraud (7) read at the special meeting of the dermatological section of the Royal Society of Medicine in December 1911, and the subsequent discussion were really the means of opening the eyes of dermatologists to the presence and frequency of the condition. The subject was gone into thoroughly. The clinical types, frequency of the infection in men as compared with women, sources of infection, case frequency of hospital to private patients, types of fungi, methods of examination and treatment were all discussed.

The next important paper was by Kaufman-Wolf (8) in 1914, in which she described the fungi found in 25 cases of cheiro pompholyx thus bringing into prominence its mycotic nature. Seventeen of her cases were due to a white fungus of the Gypseum type which since has been found to be not uncommon. A third of the cheiro pompholyx cases which she examined in Paris, Vienna, and Berlin in seventeen months showed a fungus infection.

In America Montgomery and Culver (9) in 1914, and Hartzell (10) in 1915 published short papers.

In 1915, McMurray and Norman Paul (11), read a complete paper on Tinea Albigena, which they describe as being common in Australasia on the hands and feet. They state that it was first described by Nieuwenhuis in Java in 1907, and from their description of it one gathers that it is identical with Kaufman-Wolf's type of organism. I have not seen this important paper mentioned in American Journals.

The next and probably most important contribution after those by Whitfield and Sabourand was that by Ormsby and Mitchell (12), in 1916, which created great interest in the subject in America.

This was a most complete paper from observations on 65 private patients and pointed out the difficulty in telling the type of organism present from the appearance of the lesion. Previously Sabouraud had put forward the view that certain fungi produced certain definite lesions. 1919 saw the publication of an analytical paper on ringworms of the body and extremities by White (13) from a study of 192 cases, many of which were also suffering from Tinea cruris. The value of this paper is seriously diminished by the fact that he was unable to find the fungus in any of his cases.

In an article "Dysidrosis: its parasitic nature", (14) Darier also in 1919, makes out a strong case for the mycotic origin of this condition. He mentions that most vesicular and vesicopustular eruptions on the hands and feet were not mycotic, but secondary to scabies, pediculosis and similar conditions or dermatitis venenata, and points out that the more thorough the examination in cases presenting the classical picture of Dysidrosis is the fewer the negative cases found. In his belief all cases of Dysidrosis are of mycotic origin with the exception of a few which are due to dermatitis venenata.

Other important papers appeared in 1922, by Williams (15), a further paper by Mitchell (16), with an account of Kauffman-Wolf's organism, and an important discussion on these papers, and a long article by Ota (17) principally dealing with the morphology of Tr. Purpureum (Bang) and Kauffman-Wolf's organism which he groups as a variety of Tr. Interdigitale (Priestley).

Publications had already been made by Ota on Dysidrosis in 1920 (18), and on tricho phytons in 1921 (19). All his clinical material was obtained in Manchuria.

Further contributions on the subject have been made by Lane (20), Priestley (21), in Australia, who described the Tr.interdigitale, Graffenried (22), Hodges (23), Feldman and Ochs (25), Wende and Collins (24), Greenbaum (26), White and Greenwood (long complete article) (30), and by Ruggles (27), and Weiss (28) and Hutchins (29) who wrote principally on treatment.

During the systematic examination of material from the hands and feet the discovery of organisms which were not ringworms prompted a study of the mould and yeast infections which had been reported from these situations.

This literature is not very plentiful but has been increasing in recent years, stimulated no doubt by the increased interest in the ring worms.

The principal contributions to the subject of the yeast infections as they affect the hands and feet have been made by Gougerot and Goncea in 1914 and 1915, Ormsby and Mitchell (12) (31)
in their paper on ringworm infections mention three cases in which there was a heavy infection of yeasts.

In 1917 Fabry (32) named the condition on the hand "Erosio interdigitalés blastomycetica" and described a series of cases. In 1918, Berendsen (33), Fabry (34), and Hudelo (35), contributed papers, and in 1921 Stickel (36) reported forty five cases, thirty eight of which occurred in women. An important contribution was made by Greenbaum and Klander (37) in 1922, in which they classified the normal yeasts found on the skin and described seven cases of infection. They also made important experiments on animal and auto-inoculations in an attempt to determine the pathogenicity of yeasts.

In the June number of the American archives of Dermatology and Syphilogy 1922, there is an account and discussion on a case with interdigital infection shown by Mitchell (38). Mitchell (39) again reported on three cases of this type in Deeember 1922.

The literature on mould infections of the extremities is more limited still. Whitfield in his well known paper (6) in 1911, mentions having found a heavy infection by a mould, proved to be of the helminthosporium species of the bullae of an acute bullous dermatitis. He was inclined to believe that it was pathogenic in the case.

In 1910, Brumpt and Langeron (4) reported two cases of onychomycosis of the toe nails apparently caused by Penicillium brevicaule, a chocolate brown fungus. In 1919, Weil and Gaudin (41) found the same fungus in seven cases of diseased toe nails, six other cases produced other moulds. Weidman (42) in 1920, also studied this species from a case whose toe nails showed a profusion of fungus growth.

Helpful papers on the diagnosis of yeasts from fungi in skin scrapings appeared last year by Weidman (43) and Alexander (44).

Recently I have discovered a very long article by Cianocchi in the Italian journal of venerial and skin diseases for 1908 (45), in which he describes thirty cases of a skin condition confined to the third interspaces of the hands, which would now be considered as due to a yeast infection. His illustrations show conditions identical with those depicted by Mitchell and also by Greenbaum and Klander (37). He considered the condition to be a trophoneurosis (39) dependent on the peculiar nerve supply to this space.

The particular aspect of ringworm infections with which this thesis deals was not dealt with in text books on Dermatology till comparatively recently but is now to be found, discussed at varying lengths, in most of the latest editions.

procedure of investigation.

Cases were selected for examination in the ordinary routine work of the out patient department of the Manchester and Salford Hospital for diseases of the skin.

Though numerous, precise, and detailed descriptions are to be found of the various types of lesions in ringworm of the hands and feet, many cases are seen not exactly do not conform to these conforming to these descriptions but ~~which at the same time~~ are very suggestive of the condition. This applies more to especially to ~~cases with~~ hand lesions. The types of lesion vary so much even on the same hand or foot as a result of their situation, duration, time of year, or previous treatment, that the only safe rule to follow is to examine all suspicious cases microscopically. In this connection Whitfield (6) says "of the acute vesiculo-bullous type it may be said that it almost defies the attempt at clinical diagnosis without the aid of a microscope". Ormsby and Mitchell (12) in

discussing this same question shew the fact that, "The diagnosis depends on the microscopical examination of the tissues. All vesicular scaling or desquanating areas of the interdigital or volar surfaces of the hands and feet should be carefully examined for the presence of fungi". This same theme - the difficulty in diagnosis and also the importance in frequently repeated examinations, runs through the literature. In selecting cases for special study, each one was carefully questioned and examined to exclude other factors of causation. This was ~~very~~ necessary as a large proportion of the patients attending belonged to the "housewife" group which is notoriously prone to irritative conditions on the hands due to constantly working with soap and water, polishes, cleansers and the like.

Cases of dermatitis secondary to scabies, septic abrasions, psoriasis, syphilis, localised eruptions in generalised affections such as seborrhoeic dermatitis and generalised eczema were also excluded. Trade dermatitis and dermatitis venenata were also kept in mind. Short clinical notes were taken of the cases selected, specimens collected, and photographs taken ~~if time permitted.~~

Though the cases examined were not directly under my charge, through the kindness of the Honorary Staff of the Hospital, on their subsequent visits they were, as far as other work would allow, attended by me.

Classification of ringworm infections on the hands and feet.

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In this I have followed the guidance of others, not having had a sufficient number of positive cases to allow the making of a classification.

Classifications of clinical types are given by Sabouraud (4 and 7), Whitfield (6), Ormsby and Mitchell (12), Kauffman-Wolf (8), Darier (14), White and Greenwood (30), White (13) and others, and though differing in certain details, in the main depict the same clinical features.

I cannot do better than give Whitfield's classification which he formed in 1911 and has had no occasion to alter since.

1. Acute, vesico-bullous, sudden onset in 24 to 48 hours, with all the characteristics of an acute vesicular eczema or dysidrosis, pus formation usually absent, no grouping into discs or rings and no spreading margin.
2. Chronic inter trigenous, of the toes secondary to the acute vesicular type, very chronic and difficult to cure. Whitened sodden masses of epithelium between the toes, slight vesiculation at the dorsal edge of the inter-phalangeal skin. On the sole the condition extends to about the heads of the metatarsals where it ends in desquamation, the free edge of the scales of which point towards the centre of the eruption. Condition on the hands similar but spreads much further up on to the palm. Intense itching.
3. Chronic hyperkeratotic, enormous and irregular masses of overgrown horny layer, usually on the feet and may involve the entire plantar surface, occasionally on the hands. Scattered vesicles and pustules may be found.

More recent classifications are essentially the same but elaborate the vesicular type. Thus Darier sub-divides

1. Vesicular or bullate type, vesicles scattered or grouped on the fingers and toes, palms and soles, sometimes the backs of the hands and feet. They tend to be more bullous on the sole. May become purulent and set up lymphangitis.

2. Vesico-squamous. Erythemato squamous blotches multiple and scattered or confluent into sheets, circinate in certain places only with crumbling edges, containing deep vesicles and brownish crusts from dried vesicles in and round area.

He also gives a third type. Squamous.

Dry circumsribed desquamations with rosy and smooth or squamous epidermic surfaces usually irregular with wavy edges more like an eczema. Erythemato squamous blotches on dorsum and sole of foot joining intertrigo of the toes.

The vesicular type tends to be specially well marked along the adjacent sides of the fingers, on their palmar surfaces and may spread on to the palms and I have the impression, gained by looking over the numerous illustrations in the literature, that vesicles in the centre of the palm are to be looked on with extreme suspicion (see photo 9). White and Greenwood (30) describe two types of vesicles as occurring on the fingers and toes, a large type, sago grain, usually deep, and a small, minute superficial and abundant. An important point in making a diagnosis from eczema, as pointed out by Kauffman-Wolf, is the more rapid drying of ruptured vesicles.

The hollow of the instep is a common site for vesicular and often bullous lesions as was pointed out by Schramek (46).

The essential lesion is probably in all types of the condition a vesicle. The subsequent development and clinical picture depends on the number of vesicles, their distribution and location and possibly on the type of infecting fungus.

Solitary vesicles may burst, and then rapidly dry up

leaving a small aperture, if these are grouped a cribriform appearance is produced and if the centre of the area comes away a more or less circular area is left with a fringe of scale standing up, the free edge of the scale pointing towards the centre of the lesion forming a colarette which is described as characteristic. Some vesicles may not rupture but dry up forming yellowish brown points dotted over the pink scaly dry base of the area or round its edge. Freshly formed small deep vesicles may also be found in this area. Where the skin is thicker, as on the under side of the instep and centre of palm, the vesicles may coalesce forming bullae which are specially liable to become secondarily infected in these areas.

The inter-trigenous type is due to the moist conditions between the toes, usually the third and fourth spaces, and occasionally between the fingers. Desquamation does not occur and a heaping up of sodden moist epidermis takes place, under this is a shiny pink dry base. Vesicle formation is usually to be observed on the dorsal aspect of the spaces or at least a punctured appearance of the more superficial sodden skin. The condition may spread on to the dorsum of the foot in a fan shaped manner and as the skin here is thinner vesicles are seen. On the sole the condition ends usually about the level of the heads of the meta tarsal bones with a fringed scaly margin. Where the skin is really thick over the ball of the foot and heel, the vesiculation results in the piling up of peculiar yellow semi-translucent masses of epithelium. Round this hyperkeratotic area, again where the skin is thinner, may be seen a few vesicles. An acute condition with lymphangitis from secondary infection may occasionally result in the inter-trigenous type and that occurring in the hollow of the instep.

Again a great deal depends on how soon after the commencement a case is seen. A patient may attend with the pure vesicular acute type which might in a week be described as vesicule squamous, and later simply as squamous, and

patients may be seen with all three types at the same time. The chronic inter-trigenous type tends to flare up and become much more acute in warm weather when sweating is increased.

Darier states that every case described as squamous does not necessarily follow on a visible vesicular process. This may have some bearing on the hyperkeratotic form of the disease.

It has been pointed out that unilateral vesicular conditions are to be looked on with special suspicion and that scattered vesicular eruptions on the backs of the hands and feet are usually not mycotic. The co-existence of Tinea cruris of course emphasises the importance of a thorough microscopical search for fungus from hand and foot lesions. A characteristic feature I have noticed in the numerous illustrations of the condition ~~which I have seen~~, is the marked way in which the squames in and surrounding the lesions stand up and their marked whiteness. This is quite striking.

Vesicular ring worm lesions rarely or never extend beyond the wrist or ankle in contradistinction to eczema.

In intertrigenous conditions of the toes due to hyperidrosis there is not such a depth of macerated sodden skin at the base of the spaces, and the sodden appearance extends to the ends of the toes whereas in ringworm it tends to be confined to the base of the spaces. Likewise there is not the abrupt scaly margin on the sole and all the toes and spaces are equally affected,

I have not had enough cases to be able to express an opinion on the vexed question as to whether cheiropompholyx is a definite entity or in reality a fungus infection. Darier in 1919 (14) found that 80% of his cases had ringworm fungi present in the vesicles, and expressed the view that probably all cases would be found to be of fungal origin excluding

those due to other known causes. No cultures were made. Many writers agree with him. Sabouraud (47) recently has maintained that it is a definite entity giving consistently negative microscopic and cultural findings, and points out that the discovery of occasional fragments of mould mycelium without positive cultures in pompholyx like lesions is not proof of their mycotic origin. Greenbaum (48) in 1922, realising that similar clinical lesions may have a very varied etiology tried to get over the difficulty by making careful inoculation autoinoculation and complement fixation tests. He selected a series of typical cheiro pompholyx cases with its typical recurrent attacks of limited duration and other features well marked, and came to the conclusion that it is a definite entity, but that there are pompholyx like eruptions of mycotic origi

There are few, if any, features to lead to a diagnosis of Erosio interdigitalis blasto mycetica from ringworm or other conditions occurring in the same situation, usually the third interdigital space (Photos 36, 37, 38). Greenbaum and Klander (37) could only differentiate by laboratory examination. Mitchell (49) points out that there is no evidence of vesiculation as would be expected in ring worm and that clinically the cases occur in women whose hands are constantly in soap and water.

Classification and analysis of the cases examined.

For the sake of brevity and clearness I have made this out in tabular form. The grouping into hands, feet and hands,and feet, was suggested by the site of the predominating or most suggestive lesion in each case.

	Total.	Scales		Cultures		Epidermo -phyton	Tricho- phyton	Micro- sporon.	Yeast.	Mould.
		Pos.	Neg.	Pos.	Neg.					
Hands	56	6	49	7	48		2	1	2	2
Feet	19	7	12	7	12	3	4			
Hands and Feet	16	2	14	3	13			1	1	1
	90	15	75	17	73	3	6	2	3	3

It will be noticed from this that positive cultures were obtained in two cases when the microscopical findings were negative. There were 11 ringworm infections found and 6 possibly due to yeasts or moulds.

The classification and findings of the various types of lesions in these cases have been dealt with similarly.

	Hands.		Feet.		Hands & Feet.	
	Total.	No.Pos.	Total.	No.Pos.	Total.	No.Pos.
Acute vesicular.	21	3	1		2	
Pompholyx	9	1	1	1	1	1
Vesiculo-squamous	13	2	2		8	1
Squamous	10		1		1	
Intertrigenous	2	1	13	6	1	1
Hyperkeratotic			1		3	
	55	7	19	7	16	3.

This grouping into types of lesions proved much more difficult. It was often almost impossible to decide whether to classify a case as acute vesicular, vesiculo-squamous, or as pompholyx. In the acute vesicular group I have placed all those cases which might have been described as acute vesicular eczema. In the pompholyx group were only placed cases which were considered to be typical and fully developed examples with fairly large vesicles or bullae.

More or less circumscribed scaly lesions with small vesicles or dried up vesicles scattered deeply in or round them were placed in the vesiculo-squamous group.

It will be noticed that only eleven cases of what was

considered to be typical pompholyx were selected out of the 90 cases examined. The literature abounds in references to the small number of patients of the hospital class seen with ringworm of the hands and feet. Pringle and others mention it in the discussion on Whitfield and Sabouraud's papers in 1911, but nowhere is it specifically mentioned that pompholyx is also rare in this class. True pompholyx is considered to be distinctly uncommon by the Honorary Staff of this Hospital in the out patient class.

Seven out of the 90 cases reported on were private cases (9.17.89). Three of these were positive out of a total of eleven positive ringworm infections. These three infections were all due to epidermophyton inguinale, all contracted abroad and were the only epidermophyton infections found. They also were all of the intertrigenous type on the feet. Out of the eleven ringworm cases, five were contracted abroad (Cases 9.17.89), due to epidermophyton, (Case 58) due to Tr. acuminatum, and (Case 86) due to Tr.Purpureum (Bang). Out of the remaining six, (cases) two, 28 and 69, were incidental microsporon infections and not even possibly causative, leaving four local (Manchester) cases with what I consider causative infections. These were cases 32, 79, 51 and 76, the first two due to Tr.gypseum (var.interdigitale?) and the last two to Tr.Acuminatum. The types of lesion represented by these four local cases were 32, acute vesico-bullous under one instep and between the toes, 79 chronic inter-trigenous on one foot (Photo 6), 51 vesico-squamous in centre of left palm (Photo 9), and by case 76 a Tinea circinata type beginning on the knuckle and involving the first space on one hand. (Photo 1.) Of the eleven infections four were on the hand(two saprophytic) and seven on the feet. This proportion of seven to two is roughly what has been found by other observers.

One case with marked yellow hyperkeratosis of one sole had a positive Wassermann reaction and I could never

find fungus in it. Mitchell (12) and White (13) both mention having had a case with this combination which cleared up under treatment for ringworm. Mitchell found fungus in his case. One of my intertrigenous cases had had the condition for forty-four years. The longest history I have seen reported was thirty years. Fourteen years longer than any I have seen reported

The disparity in the proportion of hospital to private patients is difficult to account for, and is the same in America as here, though In America the proportion of hospital patients affected increased there during and after the war. One would have thought that in this area after the war, with so many men returned ~~to this country~~ from the East where the condition is prevalent, more cases would be found than four out of eighty-five examined as suspicious.

In view of the suspicion that the condition is spread by laundries Whitfield's suggestion that the outpatient class are specially free because they do their washing at home, is very sound. Probably more cases in this class would be found if they came to hospital with chronic foot conditions as readily as they do with similar lesions on the hands.

One case with a lesion on the hand asked me whether she could not have got infected by strap hanging on tram cars. This struck me as possible and I include it as the only fresh suggestion I can make on the methods of spread of the infection. The photograph (18) showing the lesion running round in the web between the thumb and first finger is very suggestive but I had unfortunately to assign her to the negative group. Seems to support this hypothesis

In only two cases could I trace a possible source of infection. Case 17 undoubtedly got it from case 89, his uncle, with whom he frequently stayed. Case 89 had had a severe Epidermophyton infection of the feet for many years and the infection was probably carried by means of the bath mat and possibly the bath slippers belonging to 89 which

17 occasionally used. Case 79 with an intertrigenous condition on one foot was a Turkish Bath attendant, and these institutions have for long been regarded as notorious sources of infection. An attendant having his feet wet and bare all day would be specially liable to pick up the infection and not only that, but pass it on to others.

Only one of my cases out of eleven was a female, this is in conformity with the findings of others in this condition and in Tinea cruris. Of the total number examined 38 were males and 52 females.

With regard to the time of year at which most cases with acute vesicular lesions occur I can express no opinion only having had one case with that condition of recent origin (32). He attended in July. Most acute cases or those with acute exacerbations are reported in summer when sweating is more profuse, and anything at other times of the year which has this effect also leads to an increased number of cases. Thus the wearing of thick woollen socks, sitting with the feet too close to the fire, wearing "gum boots", or spells of warm moist weather may lead to an acute outbreak or "flare up" of an old infection.

There are considerable differences of opinion as to the role played by hyperidrosis. Some maintain that it is the factor which allows the fungus to gain a foothold, while others hold that it is induced by or at least accompanied the infection. In only four out of the 90 cases examined have I noted that there was marked hyperidrosis. None of these were ringworm cases. One was a yeast infection of the feet and a hand.

Fresh attacks in cases which have been treated are probably due to renewed activity of fungus which has been lying dormant deep down in the skin and not to a reinfection from outside such as again using old socks or bath slippers.

Affected and untreated nails may be another cause for a fresh "flare up" as has been frequently pointed out.

Of the apparent yeast infections two were in women and one in a man. All three mould infections occurred in women.

Hand lesions occurred twice in both the mould and yeast infections and an infection of both hand and foot once in each.

A considerable number of microscopical and some cultural examinations were made on patients of whom no notes were taken. These are not included. Other rare types of ringworm of the body which have been described, such as the deep kerionic, chronic lichenoid, and the intertrigenous in the axillae, below the breasts and in the gluteal fold were looked for and suggestive cases examined but none were found. positive.

History of Cases and Comments.

Case 9. (Epidermophyton infection). Private Patient, aged 50.

Had a typical chronic macerated condition in the two outer spaces of the left foot extending very slightly on to sole. First noticed as a scaly condition between the toes two years ago in India shortly after an attack of Tinea cruris.

Preparations from the deeper laminated sodden skin showed the typical short jointed mycelium of the Epidermophyton. Culture showed an Epidermphyton infection. Treatment consisted in the use of Whitfield's ointment and the thorough removal of the dead skin.

He has had no recurrence up to the present.(Nine months).

Case 89. (Epidermophyton infection). Private patient aged 78.

The condition on the feet was first noticed in India forty four years ago shortly after an acute attack of vesicular eczema on both feet.

The patient came for advise not because of his severe though chronic foot infection but on account of a very severe Tinea cruris which he had had for five months. This was very extensive, beginning in both groins and spreading round the inner side of the thighs to the gluteal cleft where the raised red infiltrated edge faded away into the macerated condition which spread out from the anus.

Both thighs and shins presented a patchy white furfuraceous scaling which suggested a trichophyton and not an epidermophyton infection as the epidermophyton is not commonly supposed to infect the flat surfaces. As was to be expected in an epidermophyton infection no infected hairs were seen.

The feet presented a very marked white scaliness over the soles and toes. On the left foot all the spaces showed the intertrigenous lesion, and the outer two on the right, the same. The pinhole appearance in the scales round the macerated areas suggesting vesicles was well marked.

The interesting point about the case was that on the

left foot all the nails were infected and on the right the big and little toe nails. These nails, yellow and friable, all showed the presence of a ringworm fungus and the only growth of Epidermophyton inguinale obtained from the case was grown from a nail. The mycelium found in the nails and from between the toes was degenerated looking and broken up. No fungus could be found in the scales on the thighs or shins. The only previous record I can find of the epidermophyton infecting nails is given by Whitfield, of two cases, in his paper in 1911. The patient's daughter living at home, began to have apparently the same condition on the feet five years ago. She was not examined. The patient's wife, living with him all these years has never developed ringworm in any form. This suggests that she has an immunity to the infection and also suggests that the clinical appearance and type of a ringworm lesion may, apart from the other factors, to a certain extent depend on a partial immunity.

At various times the patient has suffered from tinea cruris, probably infected from his feet. Unfortunately no photographs could be taken. With the exception of his nails which are still under treatment his other lesions have cleared up with full strength Whitfield's ointment.

Case 17. (Epidermophyton infection). Private patient aged 34.

A nephew of case 89.

He had the typical intertrigenous infection involving principally the fourth spaces in both feet. The condition began insidiously on the left foot in the base of the fourth space which always tended to be moist owing to a scar from a cut in childhood. The condition was noticed two years later in the same space on the right foot, the infection being probably carried by changing socks from one foot to the other.

At no time was the condition acute, and on examination there was no evidence of vesicles. In this case again both little toe nails were infected, the mycelium being found in the

nail substance. Contrary to the commonly stated belief that epidermophyton infections of the feet are always preceded, accompanied or followed by Tinea cruris, this case at no time has had that trouble.

His infection was undoubtedly got from using his uncle's bath mat and occasionally bath slippers. One foot was kept untreated for a time and on some occasions showed numerous rather broad segmented mycelia, while on others, the greatest difficulty would be experienced in finding any. If the case had not been known to be infected it might easily have been classed as negative. The photograph of the left foot, No.5, shows the chronic intertrigenous form on the foot admirably.

Both the toe nails and foot condition have remained cured so far, with Whitfield's ointment full strength, but whether any fungus is present and lying dormant waiting a suitable opportunity to "flare up" remains to be seen.

Cases 32 and 79.

These two cases are interesting because they were caused by what is probably the Tr. Gypseum interdigitale (Priestley) the occurrence of which in this country I have not found recorded. One case presented vesico-bullous lesions and the other intertrigenous, both on the feet.

Case 32. Hospital patient. Boy, aged 13.

This patient attended in July with a vesico-bullous eruption in the hollow of the right instep. The vesicles were large and in places had coalesced into bullae one or two of which had broken. The skin between the vesicles was normal. Between the toes was a redder more inflammatory condition, with smaller vesicles in various stages of development and there were numerous white thin tags of skin standing up. The condition had been present for a week and he stated that he had had two similar attacks on the same foot in the

previous ten months. A slight scaling had been present in the instep in the intervals.

The condition was very irritable. There was no special amount of sweating and no maceration at the base of the spaces. The boy's mother whom I investigated had had small "soft corns" at the base of the fourth spaces on both feet for years. These however did not suggest a ringworm infection. They were limited to the bottom of the space, there was no extension on to the dorsum or sole and there was no scaliness and no suggestion of vesicles. They suggested a harder core surrounded by slight maceration. On the centre of the left palm she had a scaly area the size of a shilling presenting and giving no history of vesicles.

Microscopically and culturally these three areas were negative which I think proves that the boy did not get his infection from his mother. He had never attended public baths and I cannot suggest his source of infection. No photograph was taken. He was also given Whitfield's ointment and has not returned in the intervening nine months.

Case 79. Turkish Bath Attendant. Aged 36. Hospital patient.

He had noticed a year previously that the fourth space on his left foot, was white scaly and very irritable. On being closely questioned he was sure that there were small vesicles on the dorsal edge of the area. During the year the scaly condition had spread along under the other toes, especially to the second which was a hammer toe. Three months previous to his attending, he had had from his description, a Tinea circinata on the front of the left thigh and a month later the same condition on

the right thigh. On examination he had a typical macerated area in the fourth space and also under the hammer toe. There was very little scaling. Suggestions of vesicles could be seen. (Photo 6). On the thighs he had slightly red scaly areas (Photo 7), as a result of previous treatment, which accounted for my being unable to find fungus in them. On his thighs he also had five molluscum contagiosum tubercles which are shown in the photograph. No infected hairs were found. Specimens from the macerated areas on his foot showed masses of branching beaded mycelia. Attending three months after case 32, the identical nature of the growth of his cultures to those of 32 was immediately noticed.

His infection was undoubtedly picked up from the floor of the Turkish Baths where he worked with bare feet, they being a frequent source both of Dhobies' itch and Tinea pedis. After two months treatment with Whitfield's ointment using up to 12% of salicyclic and 16% of benzoic acids all that remained was a small area of white skin in the crook of the hammer toe, when the patient ceased to attend.

At each visit I personally curetted away as much dead skin as possible and the importance of this removal was impressed on the patient,

Case 58. Hospital Patient. A Japanese Sailor.
Tr. acuminatum infection.

The patient presented scaly areas on both groins, the pubis, upper inner surface of both thighs running round between the legs to either side of the natal cleft and on to buttocks. These areas were studded with reddened very itchy papules. The condition began in Japan three years previous -ly. There was a very mild degree of scaliness between the toes on the right foot and a slight intertrigo in the fourth space. The scales from both foot and groin showed numerous segmented branching mycelia which proved to be of

Tr.acuminatum. The whole condition cleared up in a week with Whitfield's ointment.

Case 86. Hospital patient. Sailor.

Tr.purpureum (Bang) infection.

The patient's condition began in India five months previously as a "ring" on the right calf, it was next noticed on the tops of the toes and then spread widely practically all over the body where he had numerous semicircles and rings. The condition was extremely irritable but not painful except over the wrists, insteps and above his heels where his boots rubbed. In these situations the infection was deeper. Two months later both cheeks in front of the ears became infected. On his previous voyage his Captain had been similarly infected, the infection being worst on the cheeks.

On examination, the appearance in most areas had been altered by treatment as will be seen by photographs 28 to 31. Generally all over his legs, most marked down the front was a white branny condition which was also present on the arms. On the back of the wrists and dorsum of the feet and above the boot tops at the back of his ankles there was some thickening of the skin where the condition had been acute. There was a slight degree of intertrigo between the toes on both feet and the upper inner surfaces of both thighs showed a more acute stage of the disease with red very irritable papules. The flexures were rather less affected than elsewhere. There was a small Tinea circinata lesion on the back of the neck.

The interesting feature in the case was that he showed numerous infected hairs. These were present over the legs, pubis and on both cheeks (photo 27).

There was mild inflammation round the hairs which on the legs were dotted about as red points. A white sheath of fungus could be seen extending up the hair. Ota, Priestley and others mention that they have never seen hairs infected with this fungus. Apart from the hair infection the distribution of the fungus was

Manchester and Salford Hospital for Skin Diseases.

Quay Street,

Manchester,

TELEPHONE No.:
5120 CENTRAL.

April 20th 1923

To

The Dean

Faculty of Medicine

University of Edinburgh.

Dear Sir.

Since posting the written part of my M.D. Thesis I have found one hair of case 86 which I have stained and find that the mycelium is definitely invading the shaft of the hair. Could this be noted please in the Thesis. The slide containing the hair is with the other microscopical slides which I am forwarding. In the Thesis I said I was unable to find any fungus

consistent with previous reports and distinct from that of the Epidermophyton which infects the flexures and not the hairs. The skin from the feet, thighs and groins showed numerous long branching segmented mycelia. Microscopically there was a thick sheath of rather small spores round the hairs and strands of segmented mycelia invading the hair bulb. I could not make out any mycelia invading the shaft. I did not realise that this fungus had been reported as not infecting hairs till quite recently when practically all the specimens had been used up.

See letter attached

Both the hairs and skins from the feet gave typical cultures.

With the aid of vigorous epilation and Whitfield's ointment the patient was cured.

Case 51. Hospital patient. aged 62.

Worked in a hardware shop.

Tr. acuminatum infection.

This patient came to hospital for an acute Eczema rubrum on his left ankle. He had a subacute vesiculo-squamous condition in the centre of his left palm which had, he thought been present for six months and apart from being irritable had never caused him any trouble. It had never been acute and he did not know there were vesicles in it till they were pointed out to him. The vesicles were small and some dried up ones showed as brown points. Photograph 9 shows the condition well. Between his fingers and on their surfaces there was a slight desquamation but no evidence of vesicles. There was no infection of his feet. Examination showed fairly numerous large mycelia with rather flattened square segments, but none could be found in the condition on the ankle. A typical Tr.acuminatum growth was obtained from the palm which after two months was overgrown by a brown mould.

This patient shows that the infection need not be acute or very troublesome.

With the removal of the brown points from his palm the

the condition cleared up quickly.

Case 76. Hospital patient. A girl aged 15. Also a Tr. Acuminatum infection of the hand.

She presented a tinea circinata like infection on the back of the right hand beginning on the knuckle three weeks previously and slowly spreading out. The central part of the lesion over the knuckles showed desquamation and some superficial cracking. The spreading margin presented small papulo vesicles. The larger vesicles in the first space which was involved shows the effect of the influence that situation has on the appearance of a lesion quite apart from the type of fungus imfecting. Photo 1. The scales showed plentiful large branching mycelia with a tendency for their ends to be club shaped, and the Tr.acuminatum was easily obtained in culture from them. Her mother had a thickened lichenoid area on the back of the left hand which was thought might possibly be the source of infection. Phpto 23. However this area was repeatedly found negative.

From Cases 28 and 69 single colonies of Microsporon Audouini were grown but no fungus was found microscopically. Case 69 had a small area of small spore infection (proved by culture) above the left ear from which the contamination probably came.

Case 28, was a woman of 28 , a hospital patient with a small area of squamous dermatitis in the centre of the right palm from which the culture was made.

Case 69 was a boy of two and a half with a pustulo vesiculo squamous dermatitis on the inner side of both insteps and the outer side of both wrists. It was rather more postular on the wrists than the insteps. I was only able to obtain a photograph of the left foot (No.10) as he was very restless. This shows the condition modified by treatment. The condition which was very irritable had been present for nine

months. Though all the areas were thoroughly examined no fungus could be found. The single growth took place from material from his right wrist.

Neither of these cases were true ringworm infections.

Case 92. Hospital patient. aged 55.

Yeast infection. "Erosis-interdigitalis Blastomycetica".

She was a fat Jewess, not intelligent and with small knowledge of the English language. She had a symmetrical interstrigenous eroded condition at the base of the middle spaces of both hands. Photographs 36 and 37. The skin was white sodden and fissured, showing pink tissue underneath and was difficult to remove. The condition extended half way up to the first joint and had never been more extensive. There was no evidence of vesicles and no history of them, when the condition began six years ago, or since. She gave a history of being free from the disease in the summer and also of having had the fourth spaces on the feet similarly affected. On inspection these were seen to be healthy. Both spaces were extremely irritable.

Examination showed numerous long branching non segmented mycelia with a number of small spores in groups on and at the ends of the mycelia which characterises the infection as due to a yeast. In the cultures creamy white yeast colonies predominated. It is interesting to note that in a similar case Mitchell (49) found mycelium indistinguishable from epidermophyton but only obtained cultures of yeasts. The condition is described principally in washer women or those who have their hands much in soapy water.

Four months' treatment with Whitfield's ointment, chrysarobin, iodine and other means have been unavailing. I suspect that she was not keeping the hands dry. The symmetrical situation, chronicity, occurrence in a fat woman whose hands are frequently in soapy water and laboratory findings

are all consistent with the diagnosis.

I consider a yeast as pathogenic in her case.

Another case giving a rather similar clinical picture but different history was number 71 (photo 38) . She was a girl of 18, a clerk, but the condition had only been present six weeks in the third space of the right hand and was indistinguishable from that of the last case. I could never find yeasts or moulds in it. She was cured in a fortnight with half strength Whitfield's ointment.

Case 30. Woman aged 28. Hospital patient.

This patient had a vesicular eczema on the back of the right hand and fingers spreading round between the fingers slightly on to the palm. Duration three weeks. Fairly numerous long slender non segmented mycelia with a few small spores were found in the vesicles. In four tubes I obtained eight colonies of creamy white yeasts.

She was lost sight of after second attendance. I think probably the yeast was saprophytic in her case.

Case 93. Hospital patient. Male, aged 41. Electrician.

Condition began three years previously as a dry superficial scaling itchy area on the inner side of the right instep. Three months later a similar area developed on the same place on the left instep. Two years ago a crop of small blisters appeared suddenly in the centre of both palms but cleared up completely. Six months ago he noticed that his shins were scaly. Nine months ago a thickened scaly patch appeared in the centre of the left palm but no blisters. On examination there was a deep sharply marginated area on the left palm consisting of heaped up moist sodden skin.Photo 33. Towards the thumb space there was slight vesicle formation. Masses of macerated skin could be easily scraped away leaving a slightly yellowish base. There was a papular lichenoid area on the inner side of both thighs. Photograph shows the white dry scaly condition on the left instep and ankle.

There were no vesicles to be seen. All the toe spaces showed macerated bases, the heaped up material of which was easily removed and showing no trace of vesicles. The nails were normal. Microscopical examination revealed masses of small spores both in the material from the palm and between the toes. These spores were in clumps rather like those of microsporon Furfur, at intervals along the thin filamentous nonsegmented mycelia identifying the organism as a yeast.

A variety of organisms were cultivated both from the feet and the palm, but creamy white yeasts predominated.

The condition between the toes was more like that due to hyperidrosis, which was marked, than the yeast infections as seen in the finger spaces. It was however, much more than a simple hyperidrosis.

His condition cleared up slowly but completely with Whitfield's ointment. Whatever his original condition had been due to I consider that the palm and toe conditions with which he attended were definitely due to a yeast infection.

Case 59. Hospital patient. Girl aged 28. Bookshop Assistant. She attended with vesiculo squamous eruptions on both palms (photo 15 and 16) and on the ball of the right thumb where the condition tended to be more vesicular as it did in the extension on the left palm to between the fingers. The lesions had a fringed edge and were very irritable. They began on both palms at the same time as rather big vesicles three years previously.

In the scales from the palms there appeared fairly numerous long thin mycelia, non segmented and with what appeared to be spores at long intervals Penicullium glancum was cultivated in profusion from the scales at every attempt.

In her case the fungus was certainly saprophytic as she appeared three months later with a fresh outbreak on

both palms in which no fungus could be found and from which Penicillium could not be grown.

Case 77. Hospital patient, aged 60. Housewife.

She had a typical Pompholyx on the palms and fingers of both hands. She had a history of repeated attacks in the last three years, beginning as big deep blisters some of which burst and ran, others dried up. The areas became red and scaly and rapidly and completely cleared up.

The microscope revealed large quantities of very thin non segmented mycelia with fairly numerous small spores dotted about in the field and some of the finger like processes with terminal spores characteristic of the Penicillium group. All the cultures showed Penicillium glaucum.

I am suspicious that the fungus grew on the scales in the specimen bottle in the two days which intervened between collection and examination. This is an argument for not storing skin specimens in corked bottles before they have been allowed to dry thoroughly.

Case 90. Hospital patient. Aged 58. Housewife.

She gave a history of having had very frequent attacks of vesicular eczema over the backs of the forearms and hands for ten years. For the last three months this had affected more the interdigital spaces and fingers.

When seen she had an acute pompholyx like condition on both hands chiefly affecting the outer three spaces of the right hand and also the ulna border. In these areas were large vesicles coalescing into bullae. There was a sodden macerated condition at the base of the spaces. On the back of the left hand there were large vesicles at the base of the ring finger. The palms were free. The whole condition had begun suddenly a week before.

The photographs 34 and 35 were taken when the condition had settled down but show the desquammation where the bullae had been. The right big toe nail was thickened yellow and opaque. She did not know how long it had been in that condition.

The roofs of the bullae showed very numerous long thin branching mycelia which were not segmented. Fairly numerous conidiophores of the penicillium group type of fungus were present and some masses of small round spores not connected with the mycelium. In the substance of the toe nail there were quantities of mycelia broken up into short lengths and containing here and there a spore like body. There were no free spores. Practically every culture tube from both the bullae and toe nail gave colonies of Penicillium glancum.

The hand condition cleared up rapidly but she still continues to have vesicular eczema of the forearms. The toe nail is still under treatment.

In a personal communication with Dr.Whitfield he has informed me that he frequently finds mycelium in diseased toe nails from which he practically always gets a growth of Pencillium glaucum but he is not prepared to say that this fungus is the cause of the condition.

In the bullae on the hands it is quite possible that this rapidly growing fungus could have established itself during the week they had been present.

Methods of Examination.

Microscopical.

Having decided on the case being suitable, as much material as possible should be collected for examination and culture. If this is not done it is surprising how soon the scales from a small lesion can be used up, especially if the case is apparently negative to examination. On the patient's next visit at the end of a week the condition is so altered by treatment that a search is usually fruitless.

In practice the scales or roofs of vesicles were removed with forceps and placed in a separate small specimen bottle for each lesion or situation. In cases presenting the small brownish yellow areas of dried up vesicles, as many as possible of these were collected as these areas or points are the most likely to contain the fungus. In the intertrigenous type of case only the deeper part of the sodden skin was taken and not the free scaly edge. As the material could not be examined immediately Whitfield's injunction to place the vesicles upside down on the slide to render the mycelium visible more quickly, could not be followed. A small portion of each scale or vesicle from each area was placed on a slide, mounted in 10% liquor potassae and left for an hour or longer to soften when the coverslip was gently pressed down and the specimen examined under the microscope. Heating the preparation though much quicker in action produces a confusing granular appearance and dulls the field. With thick specimens it is as well to leave the slide overnight having ringed the coverslip with glycerine to prevent evaporation. Having got the preparation into a single cell layer film the whole slide was gone over using a mechanical stage and the 16 m.m. objective with the substage condenser well down and the diaphragm nearly closed.

Anything in the least suspicious of fungus was examined more carefully with the 4 m.m. objective preferably

using no substage condenser or diaphragm. In this way by taking a portion of every scale in the bottle and using a mechanical stage a systematic examination can be made of every lesion.

In every case numerous similar examinations were made before it was given up as apparently negative. On subsequent visits any fresh lesions were also examined.

Negative examinations prove nothing.

Darier is very insistent on this point especially in cases of dysidrosis where he holds that a patient enough search will always be rewarded. A foot/one case (17) was left untreated to provide specimens. Frequently, selected scales from it failed in their purpose. Similar experiences have been frequently pointed out. The fault is probably due to selecting the wrong scales or the very scanty presence of the fungus during a quiescent period.

Fallacies to be avoided in microscopic examinations are numerous.

Oil droplets from ointment applied in treatment may be mistaken for spores. They however vary in size and do not appear if the scale has been previously soaked in ether.

There is an impression amongst practitioners, possibly fostered by the terms "small and large spored" ringworms, which they know, that spores are the elements to be looked for in scales. In my experience anything suggestive of spores may be disregarded unless very numerous. If spores are found mycelium is sure to be found on further search. The edge of a small squame superimposed on a larger one, and also intercellular spaces may look very like mycelium till the cover slip has been pressed down making a film of single cell thickness.

A fairly thick squame examined immediately before it has had time to soften may reveal no fungus; left some hours and

pressed out numerous threads may be seen.

Heating the preparation when examining scales from known positive cases certainly hastens the examination, but in unknown cases heating, especially to near boiling produces a granular appearance, partly due to breaking up of the cells and partly to crystallization of the liquor potassae which dulls the field and may hide scanty mycelia.

Staining methods for showing the presence of fungi, were not found satisfactory. They are too slow and the results too uncertain and not nearly as much material can be examined in the same time, as by using the liquor potassae method,

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Culture.

Cultures were made from all cases examined whether they showed the presence of fungus or not,

This entailed a considerable amount of work but was rewarded by cultures of Microsporon Audouini being obtained from two cases, (one colony each) whose lesions did not show the presence of fungus microscopically. Both cultures were obtained from hand lesions and the cases (28 and 69) have already been described.

Mitchell (16) states that he has never obtained a positive culture in a case in which he failed to find the organism microscopically. Williams (15) however mentions having obtained cultures three times from hand cases when other examination proved negative, and cites a case where a fresh bout of vesicles on hands and feet occurring four days after an acute localised vesicular eruption which contained fungi, proved to be negative on examination. He believes that this secondary eruption was due to toxic absorption and of the nature of a trichophytid. Some cases of positive culture and negative examination may be explained by the supposition that the culture was taken from the original lesion and the

microscopical examination made on the secondary lesion. It is possible that these secondary vesicular eruptions are not uncommon and that the negative finding in them is misleading thus coming back to the necessity not only of the selection of the right material from a lesion but also of the right lesion. This I find is pointed out by Williams in the association discussion on his paper.

All cultures were made on Sabourand's proof medium, the "Maltose brute" and Chassaing peptone being obtained from Paris. At first 3% peptone agar was used with the idea of subsequent transplanting on to proof medium but as growth did not seem satisfactory on this the plan was abandoned.

The material for cultivation was selected from the most likely looking specimen or those containing the most fungus. Portions the size of a pins head after having been placed in absolute alcohol for three to five minutes to inhibit the growth of bacteria, were firmly placed on the media, three or four to the tube, with the aid of a platinum loop. Frequently a small hole was scooped in the media into which the material was placed. If this was not done, in a few days time, the specimen was seen to be dry and standing up away from the media and no growth took place. Gentian violet in the media as a restrainer for gram positive organisms as advocated by Farley (50) was not used as he says it has no restraining influence on the ordinary saprophytic moulds and yeasts which formed the great majority of the contaminants in my cultures.

Hodges (23) advocates its use but does not say whether he uses it, while White and Greenwood (30) found no advantage in using it. Other recent writers do not mention its use.

As a minimum sixteen plants were made, frequently many more, and the tubes kept at room (warm) temperature. During cold weather they were placed on the top of a paraffin

oven.

As this investigation was primarily clinical, neither Petri dish cultures nor animal inoculations were made.

Hanging drop preparations were not made for the reason that they require daily attention and study which could not be given, and that unless one is a trained mycologist with a considerable amount of time, the results of the microscopical study of ringworm cultures are misleading.

Even a slight knowledge of the literature leaves one impressed with the difficulty in identifying species of ringworms, not only microscopically but also by the naked eye appearances of their cultures.

Ota (17) describes three types of Tr. Gypseum interdigitale and three of Tr. purpureum principally differemtiated by their microscopical appearances and it is well known that even very slight differences in media, temperature of cultivation and the like cause differences of growth. Exposure to various amounts of light during cultivation also has an influence on the development or fading of colour.

No variations in cultures from the same lesion or from different lesions on the same patient were noticed, though Hodges (23) mentions one case where primary cultures of Tr. purpureum from thigh and nail lesions of a patient, grown under identical conditions presented fairly marked differences both micro and macroscopically. These however did not persist in sub cultures. Wende and Collins (24) describe four cases where two types of Epidermophyton inguinale were grown from single lesions. The differences consisted in the persistent development of a particular colour in their phom or phic growths with a persistent microscopical finding.

Sabouraud states that only one type of fungus is found in the same case and in the same lesion, though I can see no reason why a person suffering from a chronic epidermophyton infection on the feet should not have an incidental

acute trichophyton infection of some other part of his body, and Mitchell (16) cites a case of this with the situations of the two fungi reversed. Very frequently, differences in the appearances of cultures are probably due to the presence of a contaminating mould or bacteria. Hodges does not consider this possible in his case.

That this symbiosis might account for the great differences in appearance in skin lesions caused by the same species of fungus is disproved by the fact that inoculations of pure cultures produce many of the characteristic types of ringworm lesions.

Unfortunately the use of a micrographic apparatus could not be obtained till quite recently by which time the fungi in the scales had become distorted and many of the characteristic microscopical appearances of the cultures had disappeared.

As will be seen from the tabulated form previously given, out of 90 cases examined with hand and feet lesions only eleven cultures of ringworm were obtained. These consisted of epidermophyton, three times, from the feet, trichophyton six times, twice from the hands and four times from the feet, and microsporon twice from the hands in neither of which cases was the fungus found in the scales.

In no case when the fungus was found was a growth not obtained through at least 50 plants were made from case 89 (E.inguinale) from the groins, between the toes and from the toe nails, before a single growth was obtained and this from a toe nail.

Though growths were obtained in all cases, the number of colonies were comparatively few. This I can only explain by some possible fault in the preparation of the media used or method of culture as the mycelia were reasonably abundant in the plants, though only two cases (32) and (89, in the groin) presented really acutely active lesions.

This single growth of E. inguinale was of the small button like type as illustrated in Les Teignes. Two similar growths were obtained in one tube from case 17.

Typical growths of this organism were obtained from cases 9 and 17 both with chronic intertrigenous lesions on the feet (Photo H.B. & C.) In all these three cases the characteristic large septate fuseaux appeared (Microphoto 1) Subculture produced very rapid white pleomorphic development.

Of the trichophytons, both those from the hands were Tr.acuminatum (cases 51 and 76). From the feet were grown Tr.acuminatum (case 58), Tr.Gypseum var.interdigitale ? (Cases 32 and 79) and Tr. purpureum (case 86). Case 51 (vesicles in centre of palm)produced a rapidly growing typical pure white culture (photo A.D.E.) . At the end of about a month this took on a chocolate brown colouration probably due to a contaminant. Its subculture from the first had this brown tint but in other respects was similar to its original.

Case 76, presenting a Tinea circinata like lesion on the back of the hand (photo 1) also grew a typical acuminate culture.As will be seen from the photographs A and D, its early development was noticeable for the prominent central knob. Later the margin grew and became radially furrowed. Long white duvet was an early development. The third acuminate growth (case 58) was from the foot and buttock of a Japanese sailor with scaly lesions on these areas. (Photo G & A). Both areas produced a typical white growth with central knob and radiating furrows but with less development of white duvet than cases 51 and 76.

Microscopically, cultures of these three cases showed the typical and simplest of all culture pictures - simple thin conidiophores with lateral small pyriform conidia.

Tr.purpureum was grown from a sailor from India (Case 86) presenting practically universal ringworm including a

Tinea Barbae of the cheeks. As mentioned before I can find no previous record of this organism affecting hairs.

After about a week the culture presented a small central white elevation surrounded by a thin slightly yellow zone. In the first three weeks it was covered by a very short white duvet. Gradually this zone extended, the central knob became slightly radially furrowed, round this was a grayish granular zone and outside this again concentric zones of lemon yellow. At the end of three weeks the back of the culture took on a beautiful tint of purple, best seen where the culture grew on to the side of the tube and also showed through slightly from the front between the concentric zones of lemon yellow. Later the surface became cream coloured and granular and the purple colour tended to fade. (photos F.E.D. & C.)

The organism was grown both from the beard hairs and the foot. Cranston-Low was shown these cultures and agreed as to their classification.

The growth of my cultures appeared to be much thinner and not so furrowed as those illustrated by Hodges (23) and Ota (17).

Microscopically, my notes say, "Rather like Tr. Acuminatum with its lateral conidia but also contains long thin divided fuseaux", a description which corresponds to the illustration given by Hodges.

The organism has been described by Castellani, Bang and probably Priestley under different names. Bang, Ota and Hodges obtained sparse results in animal inoculations the spores and mycelia being outside the hair bulb. Later Ota obtained two results in which the mycelia were seen in the hair. In my case with actual human hair invaded, the smallish spores forming a mass round the shaft of the hair like a microsporon could be seen as beaded mycelia to invade the bulb but not the shaft of the hair, thus placing it in the "Endo-ectothrix"

-8-

group of trichophytons.

Most difficulty occurred in the identification of the cultures from Cases 32 (large bullae in instep) and 79 (inter-trigofeet) which were obviously the same fungus.

These I believe to be Tr. Interdigitale first described by Kauffman-Wolf (8) in 1914 as occurring in vesicular pompholyx like eruptions on the hands and feet in France and Germany, and later by Mitchell in 1916 (12) and 1922 (16), Priestley (21) in Australia in 1917, Ota in 1922 (17) in Manchuria (3 types) and Hodges in 1921 (23) in America from the nails. I believe the fungus described by McMurray and Norman Paul (11) in 1915 as occurring in Australasia to be the same. This organism is apparently quite common, Kauffman-Wolf found 17 out of her 25 cases due to it and Mitchell 33% of his.

It is described as a rapidly growing fungus presenting a fluffy white duvet, developing a central button in about a week also covered by white duvet, the areola rapidly becomes granular and cream coloured and white pleomorphic growth begins early.

My cultures showed very long hyphae on the central button and the cream colour gradually spread out from the centre. Later the central button became ridged and later still cracks developed on the ridges, exposing the darker growth underneath. My cultures are identical with those depicted by Hodges (fig.11) Mitchell (16) (fig.11 12 and 13) and Ota (fig.10.) as my photographs A and D show.

Sabourand is the opinion that this fungus is closely related to Tr. equinium. That my cultures were not of this organism is proved by the fact that they both gave rapidly growing fluffy white colonies on potato while Tr.equinium gives a yellow growth (photo 1.)

On 3% peptone agar I obtained pure white fluffy colonies with very small central knobs and the cultures remained white.

On proof media my cultures from the back showed a brownish red discolouration which is characteristic.

Another characteristic as mentioned by Kauffman-Wolf and Mitchell is the difficulty in getting the growth off the media and difficulty in teasing it out for microscopical examination.

This examination showed numerous branching mycelia with a few laterally placed conidia, but the most obvious feature was the masses of oval conidia. The conidia are very loosely attached to the mycelia. A few spirals were seen but no fuseaux which characterises the growths as of the Kauffman-Wolf type according to Ota. My microphotographs (11 and 13) are very similar to those given by Mitchell (16) in his figures 6 and 17, except that no spirals are shown.

I could find nothing in Les Teignes to correspond to these two cultures though they rather resembled Tr.lacticolor. From Tr. plicatile they differed microscopically.

Cranston-Low to whom I showed some of the older cultures suggested that they looked rather like Tr.crateriforme flavum which he says is by far the commonest trichophyton in his experience in this country, however at no time did they show more than a cream colour.

I cannot find any records of this fungus having been isolated in this country.

With regard to the two microsporons grown I look on them as accidental contaminations of the hand lesions though Sabouraud (Les Teignes p.450) mentions a circinate lesion on the hand of a young woman due to M.Audouini and White and Greenwood (30) had one hand case apparently due to M.lanosum.

Case 28 which presented a scaly dermatitis in the centre of the right palm, gave one growth of M.Audouini which was not quite typical probably due to the presence of some other organism.

Case 69, a child of two and a half, who had had scaly rather pustulo-vesicular lesions on the wrists and ankles for a year also gave a single growth of M.Audouini

(photo E) from the right wrist. All four areas were examined and cultivated repeatedly with negative results. The same organism was cultivated from a small patch of ringworm in the hair behind the left ear.

The viability of ringworm fungi in scales having an important bearing on the spread of infection, notice was taken of the longest period after collection at which a growth was obtained. This was five months from case 76 (Tr. acuminatum). In all my other positive cases no growth could be obtained after a few weeks though repeated attempts were made. In this connection it was noted that fewer contaminations appeared on tubes, the planted material in which had been allowed to dry thoroughly. Whether this failure was due to the method of storing the material in bottles, faulty culture media or technique it is difficult to say.

Mitchell (16) mentions having obtained cultures of E. inquinale six and ten months and of Tr.interdigitale ten months after collection.

Farley (51) in his article on the subject, found that one thir d of the Epidermophyton scales was viable after more than five months and obtained growths in three cases after 400 days. He obtained no growth after 500 days.
He quotes Dold(s (52) work in China, who had no growth from Tinea cruris cases after 30 days. Both stored their material in sterile envelopes and their different results ~~is~~ are difficult to explain.

Mitchell also obtained a growth of Epidermophyton after boiling the specimen in liquor potassae and rightly points out that this rather strengthens the argument that ringworm or Dhobi itch may be spread by laundries even though the clothes are boiled.

Dold, while admitting that the tenacity to life of some ringworms is remarkable, is of the opinion that this should

not be over-rated.

By far the commonest contamination of cultures was from Penicillium glaucum and a creamy white smooth yeast. This did not render the investigation of cases with a yeast or fungi infection other than ringworm any less difficult. Most contaminations were observed from material from the feet.

Only those cases with marked microscopical findings in the scales were examined as frequently one or two mycelia obviously not of ringworm origin were found in the preparations. These latter were looked on as simply saprophytic and not possibly the causal factor of the lesion.

Microscopically there is a difficulty in distinguishing between fungi and yeasts as three of the five yeast groups have well developed mycelium. In the other two it is only slightly developed. No yeast however has the finger like spore bearing terminations of the Pencillium group.

Weidman (42) points out that the large conidia of some fungi resemble and might be mistaken for yeasts in scrapings, he also mentions having cultivated nine different species of mould from diseased toe nails on two examinations.

Two of my three yeast cases (92 and 93) showed the mulberry grouping of the spores on or at the ends of the long thin branching mycelia which Alexander (44) lays such stress on in making a diagnosis of a yeast as against a ringworm infection.

Weidman (43) in a recent paper also points out the importance of noticing this grouping.

This clumping of the spores which was not unlike the picture given by microsporon furfur was not found in any but fresh preparations from the lesions.

The third yeast case (30) showed numerous long thin branching mycelia segmented at long intervals and a few small spores not specially connected with the mycelia.

I found three cases in which the predominating growth was of Pencilium glaucum 59, 77, and 90. Their lesions

were packed with fungus and the last two showed the fingerlike conidiophores typical of the Penicilium group.

Creamy white yeasts predominated in the cultures from cases 30, 92 and 93, the last two as I have said showed the yeast grouping of spores in the fresh preparations. The growth began to show on the media in two or three days and ceased in about ten days without reaching the glass wall of the tube. The tubes had a strong smell of fermentation.

Microscopically the growth consisted of large usually double contoured organisms ~~hanging~~ varying slightly in size and occasionally showing budding. A few short rather thick strands of mycelium could usually be made out.

It is difficult to classify these growths amongst the yeasts but they most resemble Type II a cryptococcus, as illustrated by Greenbaum and Klander (37) in their article on yeast infections, though their culture gave no fermentation. They quote Hanna who had shown how easy it was to obtain new species of yeasts by obtaining three distinct species from one isolated cell.

A case, which I have not included which had a recurrent acute intertrigenous condition in the gluteal cleft and round the scrotum showed on examination fairly numerous fine branching mycelia with a few small round spores dotted over the field. He gave the creamy white organism in pure culture and I cannot help thinking that this was the cause of his condition.

These mould and yeast cases I have already described clinically.

S U M M A R Y.

Of the ninety selected patients examined only eleven gave positive ringworm cultures. Two of these were of Microsporon Audouini and their growth from the lesions accidental. The fungus was not found microscopically.

Of the nine others, three were due to Epidermophyton inguinale These three were from foot infections in private patients, (seven private patients were examined in all) contracted abroad, and were the only Epidermophyton infections found.

Of the remaining six patients, two contracted their disease abroad and had more or less generalised infections with foot involvement, one due to Tr.acuminatum, and the other to Tr. purpureum (Bang). This latter case had hairs on face and pubis affected. The fungus formed a microsporon like sheath round the hair and also ~~involved~~ invaded its bulb.

I can find no previous record of the occurrence of such infection by this fungus.

The remaining four infections were all contracted locally, two being due to Tr. acuminatum, both from the hand, and two, both from the feet, due to what was probably the Tr.Gypseum interdigitale. Though Kauffman-Wolf found this fungus not uncommon on the Continent, I can find no previous record of its having been found in this country. The Epidermophyton was isolated from the nails in two cases. It will be seen that only four out of eighty five patients living in this area had ringworm infections.

Only two out of the nine infections which I consider causative were on the hands and all but one in men. No examples of trichophytids were seen. Of the total series there were eleven cases of what was considered to be typical pompholyx, and only one of these was positive. This small proportion may be due to faulty examination.

Three cases were discovered with heavy infections by a mould and from these Penicillium glaucum was grown most

frequently. In two patients the infection was on the hands, and in one on both hands and foot.

There were three cases with heavy yeast infections, confined to the hands in two, and on the hand and foot in the third. Shiny creamy white yeasts predominated in the cultures. One of these was undoubtedly a case of Erosio interdigitalis Blasto-mycetia and in the other I also consider a yeast as the causative factor.

- - - - - - - -

CONCLUSIONS.

Ringworm infections of the hands and feet in the hospital class of patient are rare. This is a statement born out by the observations of the others elsewhere.

In this class, the type of eruption simulating that caused by ringworm is probably produced mainly by external irritants.

Pompholyx is also rare in this section of the community and would seem to be a definite entity.

The occurrence of Tr. Gypseum interdigitale in this country is described for the first time, and the first record made of Tr.Purpureum (Bang) infecting human hairs. It probably belongs to the "endo-ectothrix" group of trichophytons.

The Epidermophyton infects nail substance.

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To the Honorary Physicians of the Manchester and Salford Hospital for Skin Diseases I should like to express my deep indebtedness for the use of the clinical material and also for many helpful suggestions in connection with the clinical side of the work, and to the hospital for the use of the laboratory and its materials.

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Clinical Photographs.

1.

Case 76. Trichophyton acuminatum. Duration 3 weeks. Margin studded with small papules vesicles.

2.

Case 67. Negative. Circinate spreading lesion on palm ring and first finger. No vesicles present though there had been a history of them.

3.

Case 78. Negative. Reddened very irritable scaly lesion on dorsum and sides of toes. A few small vesicles were present. There was a sodden condition between the toes. Duration one month. Condition looked very suspicious of ringworm but probably was of coccal origin.

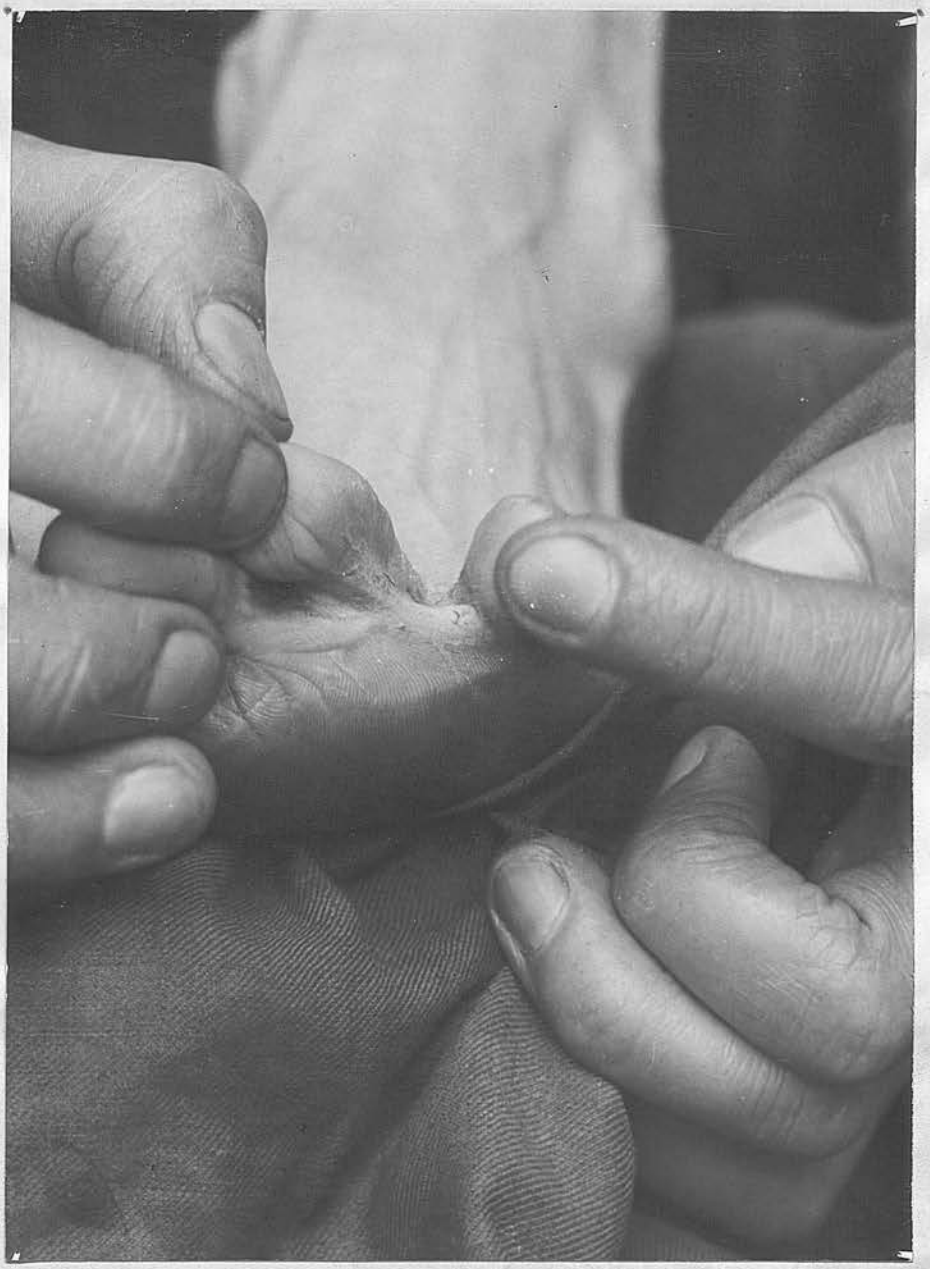
4.

Another view of the above.

5.

Case 17. Epidermophyton inguinale. Characteristic appearance during the quiescent stage. The condition had never been more active than this. Duration 10 years. No history of Tinea cruris. Both little toe nails were also affected.

6.



Case 79. Tr. Gypseum interdigitale?

Turkish Bath attendant.

maceration in 4th space and also under hammer toe.

Duration 1 year.

7.

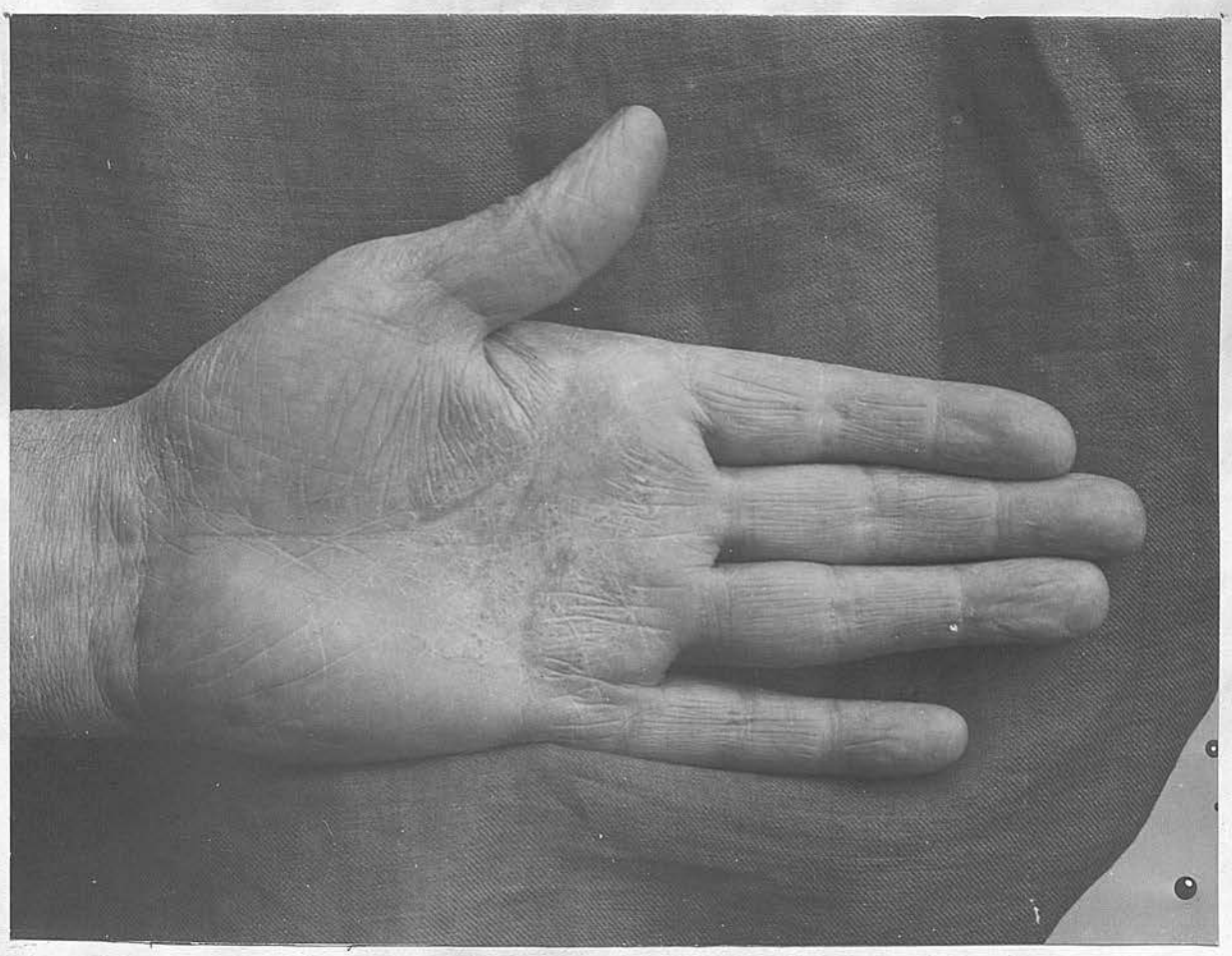
Scaly condition on thigh of three months duration.

X. Molluscum Contagiosum tumours.

8.

Case 97. Negative. The maceration at base of first and second space was tougher and more yellow than that due to ring worm and did not come off in lamellae. Had a small desquamating area on dorsum of foot connected with the space shown. Two months later developed Psoriasis of wide spread distribution.

9.

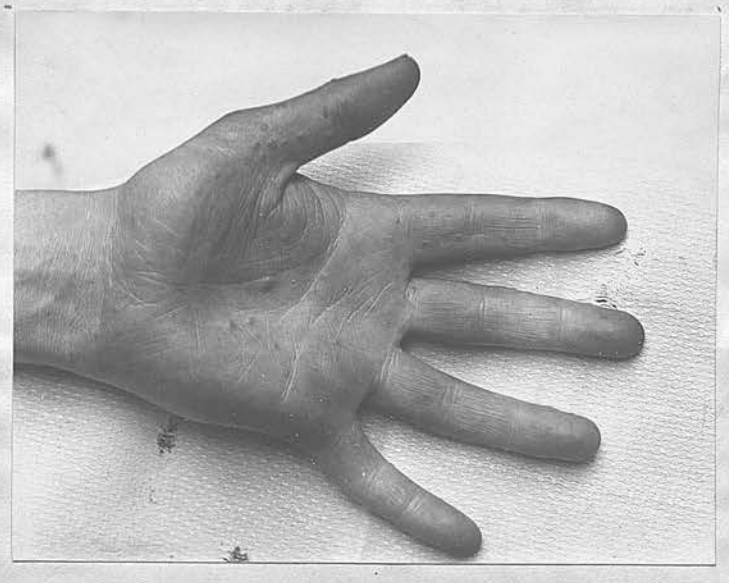


Case 51. Trichophyton acuminatum. 6 months duration. Showing small vesicles and brown dots the remains of dried up vesicles.

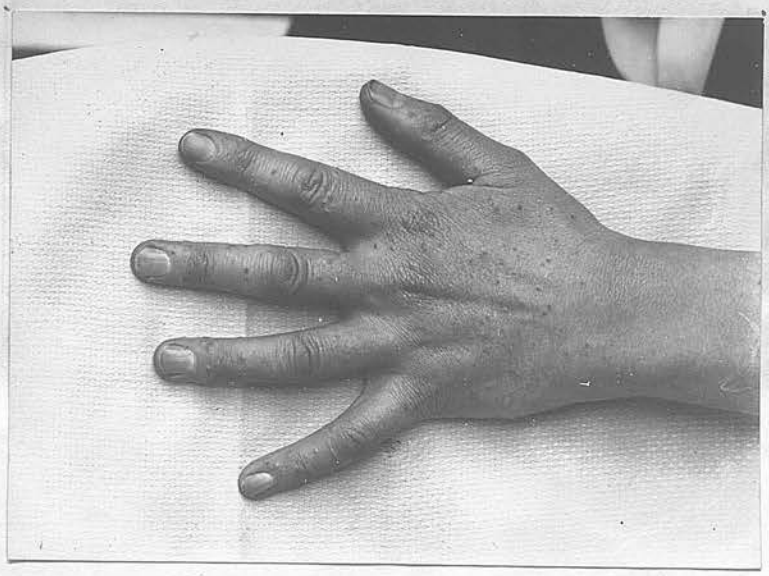
10.

Case 69. Negative. Had similar lesions on both wrists and the other ankle. Microsporon Audouini was grown from the right wrist but not found microscopically. He had a small patch of ringworm due to the same fungus on the scalp.

11.



12.



Case 95. Negative Cheiropompholyx distributed all over both hands. of sudden origin Duration one week. Rest of the body free. Probably of toxic origin.

13.

Case 56. Negative Duration one week.
Acute onset with papulovesicles.
Similar condition on left hand.

14.

Case 63. Negative. Recurrent attacks of vesicles.

15.

16.

Case 59. A fairly plentiful mould was found microscopically in lesions on both hands. In the cultures Penicillium glaucum predominated. The mould was certainly saprophytic.

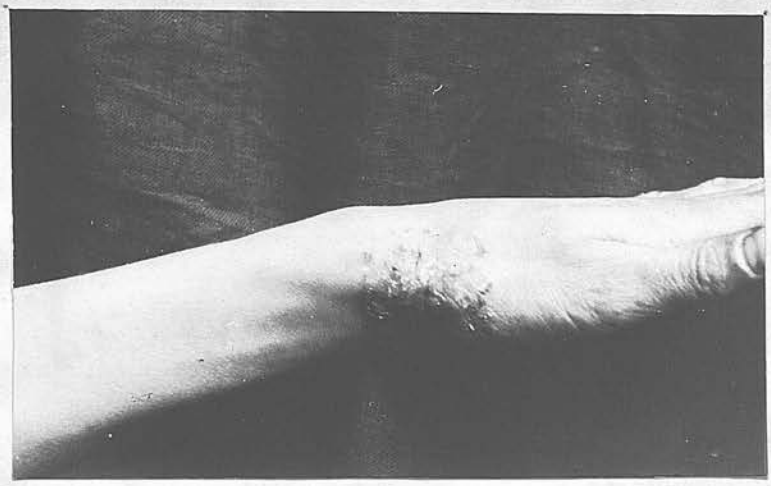
17.

Case 70. Negative Vesicular spreading dermatitis on both palms and the fingers where it was more vesicular. 1st attack. Sudden onset. Duration 5 weeks. Lesions probably too numerous to be mycotic.

18.

Case 60. Spreading circinate eruption in fleexure with vesicular margin. From "Strip hanging"? Negative.

19.

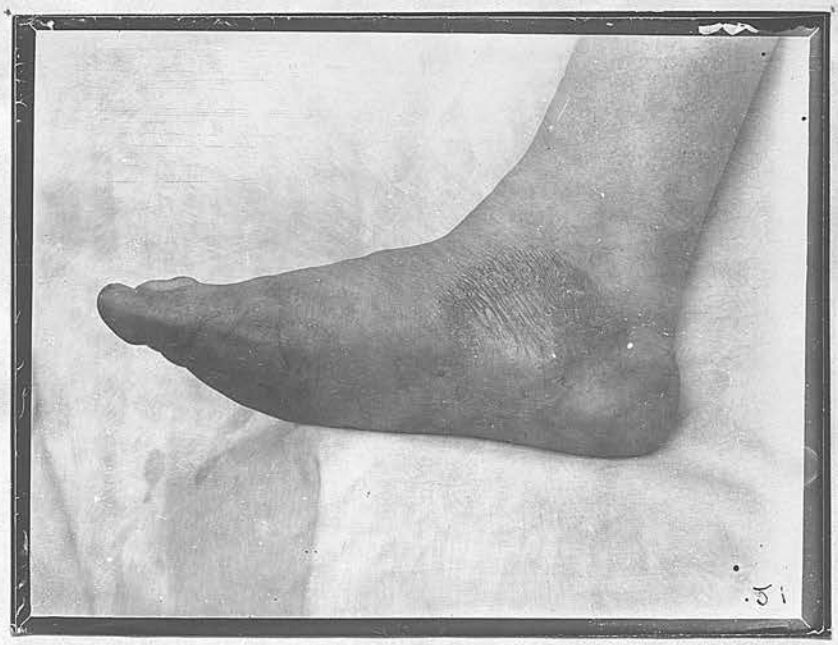


Case 53. Negative. Vesiculo squamous lesion beginning as rather large vesicles a month previously. Rest of hands free.

20.

Case 21. Negative Squamous lesion of 6 months duration. Began acutely with vesicles. Toenails normal. 4 years ago had acute vesicular condition on both palms which lasted a Summer. Present condition was very intractable to treatment but yielded to X rays.

21.



Case 94. Negative. Erythematosquamous condition of 3 months duration. Similar condition on left thenar eminence. (Photo 22) Very irritable. Cleared with X rays.

(These two photographs should be transposed.)

22.

Case 94. Negative. Erythemato squamous lesion of 4 months duration. Similar condition on dorsi right ankle. (Photo 20).

23.

Case 75. Negative. This patient was the mother of case 76 (photo 1) with a tinea circinata on the back of the hand.
It had a scaly lichenoid appearance.
Duration 2 years.

24.

Case 61. Negative Yellow hyperkeratosis palm. Similar condition on ball and heel of left foot. No vesicles. Wassermann negative. Duration 8 months.

25.

Case 65. Negative. Marked hyperkeratosis of heel and ball of left foot. Duration 10 years. Big toe nail similarly affected. (photo 26). Wassermann +++. Similar cases have been reported which did not clear up with anti-syphilitic treatment but in which a fungus was found. They cleared up with whitfield's ointment.
No fungus could be found in sole or toe nail.

26.

Case 65. Negative. Toenail of the case with hyperkeratosis. Orange yellow as was the sole. (photo 25).

28.

27.

Case 86. Trn. Purpurenum (Banq)

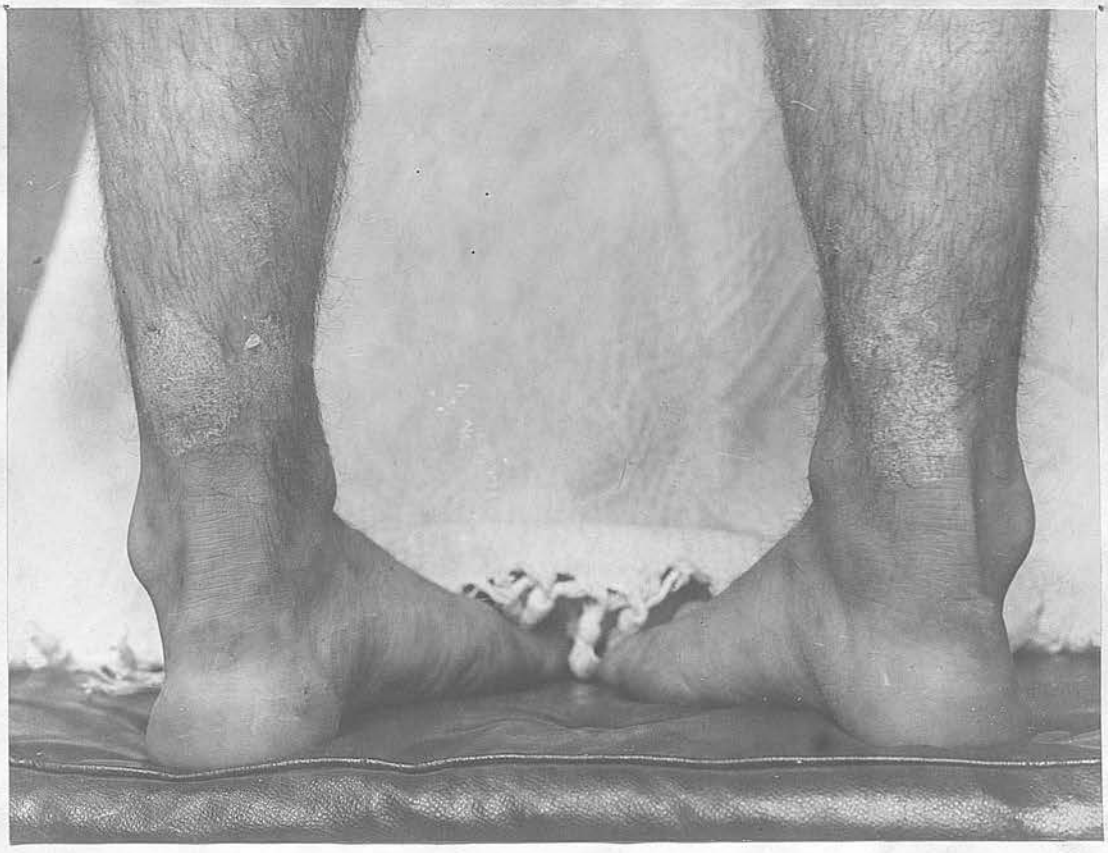
Scaly condition of insteps shins and thighs with more erythematous lesions on upper part of thighs. The infected hairs cannot be seen.

Tinea Barbae of cheek.

This fungus has not previously been reported to infect hairs.

29.

30.



Case 86. Tr Purpureum (Bang)

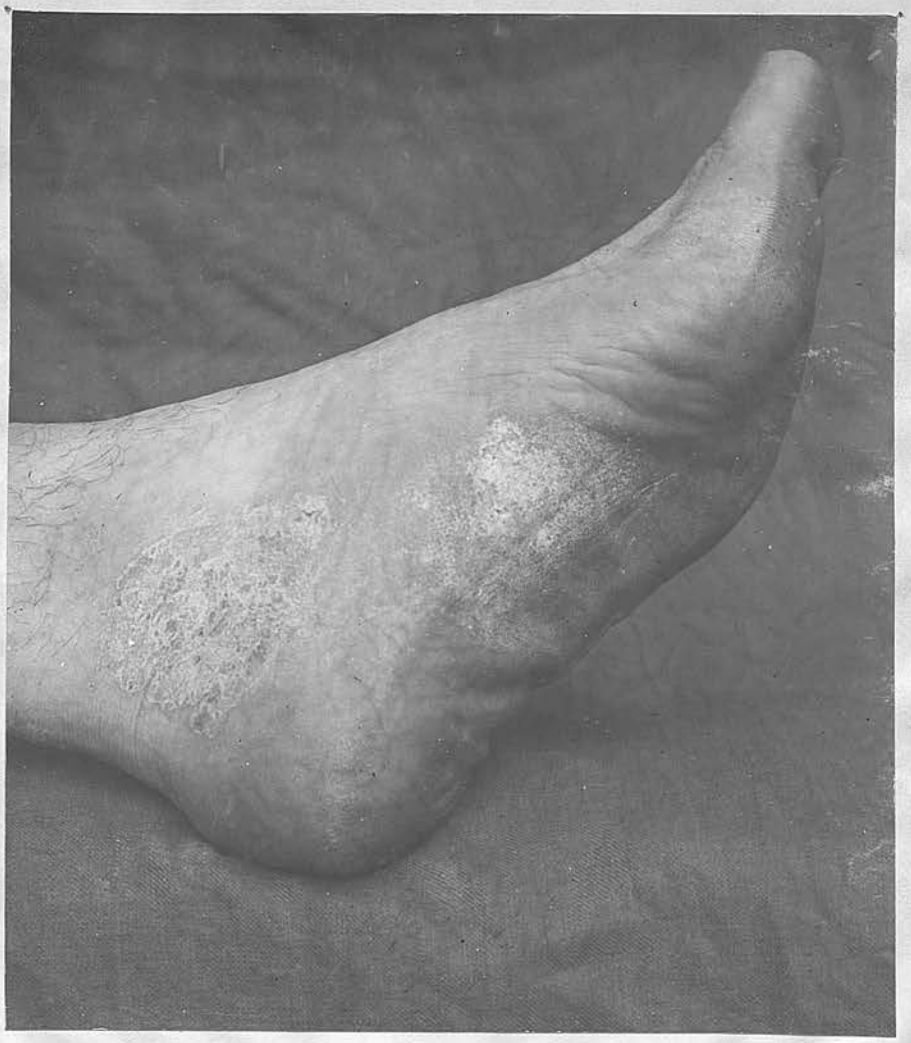
Condition on forearms and at boot tops
No infected hairs can be seen.

31.

Case 86. Tr. Purpureum (Bang)

A closer view of instep.
x infected hairs.

32.



33.

Case 93. A Yeast infection.

Showing sodden macerated condition in centre of palm the material from which was packed with yeast mycelium and spores in characteristic yeast groupings
Duration of palm condition 9 months.

Scaly lesions on foot. There was a similar condition on both thighs & shins.
There was a marked intertrigo between all toes showing the same yeast.

34.

35.

Case 90. a fungus infection?

Showing the remains of the bullae at the base of the fingers. There were very plentiful mould mycelia and sporangia in the bullae. The right big toenail was also affected and showed mycelia. From both nail and bullae Penicillium glaucum was grown in profusion.

The lower photograph shows the vesicular eczema on the forearms.

36.

37.

Case 92. a yeast infection typical Erosio interdigitalis Blastomycetica (better Saccharomycetica)

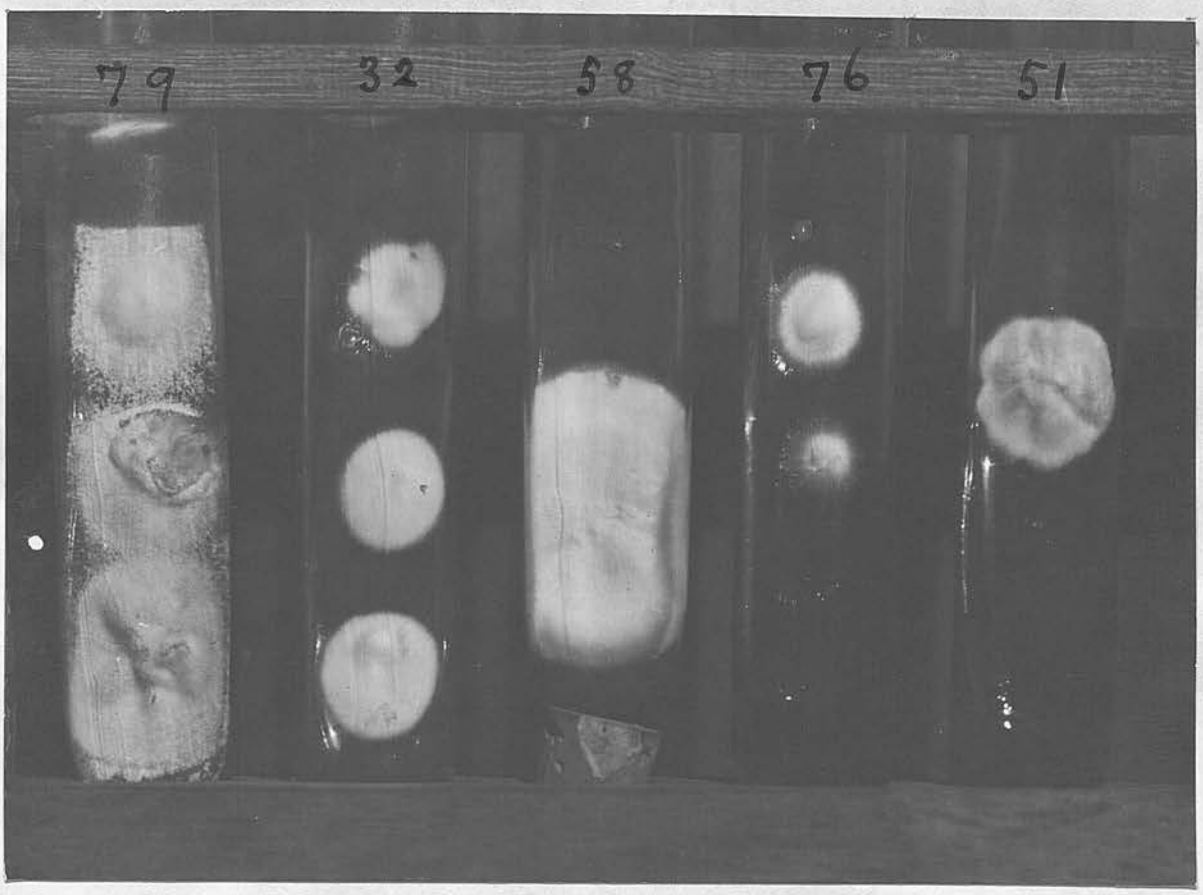
Duration 6 years in a fat woman who had her hands constantly in soap and water. She had an exactly similar condition in the third space on the ~~left~~ right hand. The material contained plentiful typical yeast mycelia and budded spores.

X most intractable to treatment, the condition remains after 4 months.

Case 71. Negative In appearance typical of
Erosio interdigitalis Blastomycetica.
Duration only 6 weeks. Unilateral.
Cleared up with a fortnights treatment.
No yeasts or ringworm fungi ~~or yeasts~~
could be found in the material.
Probably of coccal origin.

Photographs of Cultures.

A.



Case 79. Tr Gypseum interdigitale (?)

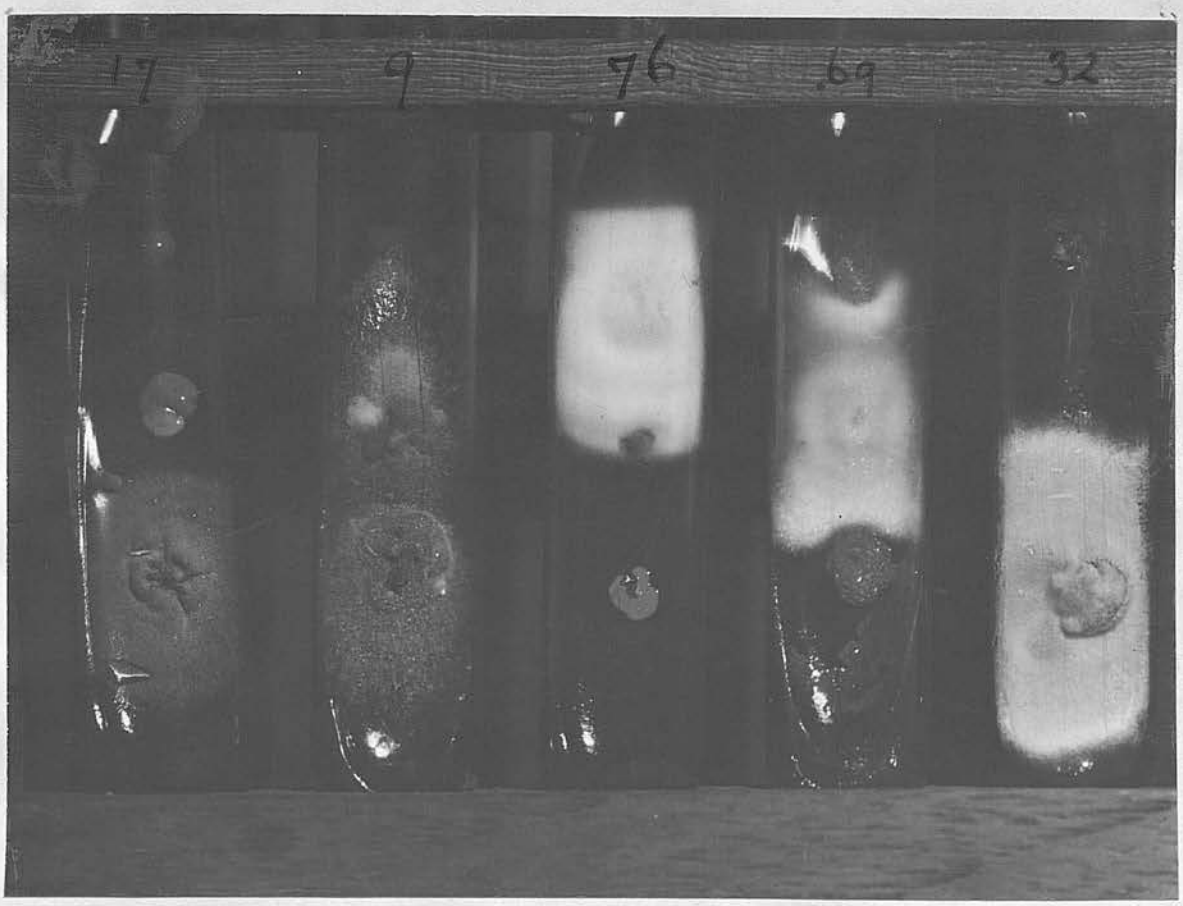
" 32 " " " on. 3% peptone

" 58 Tr. Acuminatum. old culture.

" 76 " " Young culture.

" 51 " " from hand.

B.



Case 17. Epidermophyton inguinale

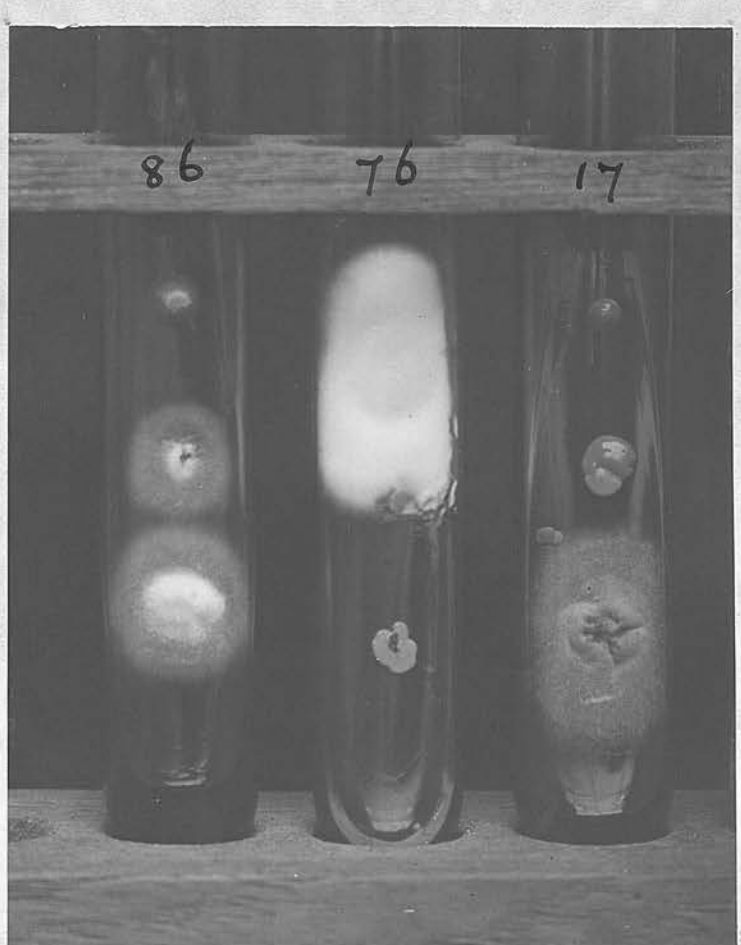
" 9. " "

" 76. Trichophyton acuminatum. pleomorphic growth.

" 69. Microsporon audouini. from wrist.

" 32. Trichophyton gypseum interdigitale?

C.

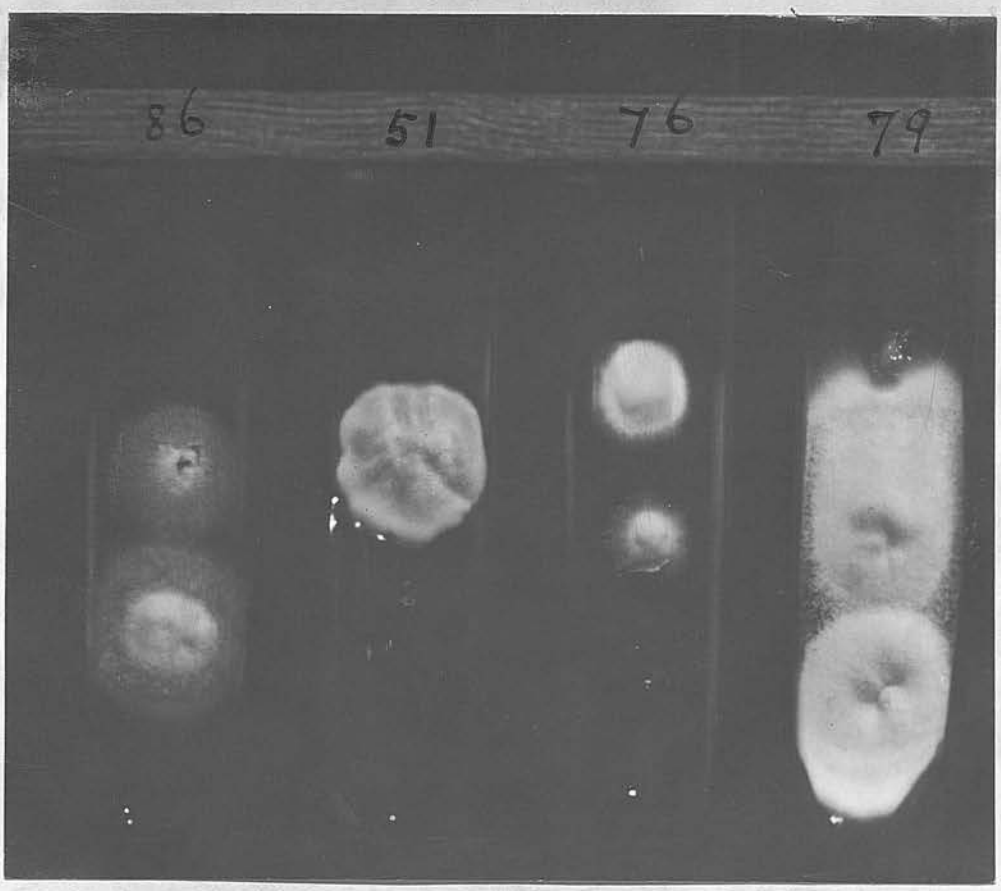


Case 86. Trichophyton Purpureum (Bang)

" 76. Trichophyton acuminatum.

" 17. Epidermophyton inguinale.

D.



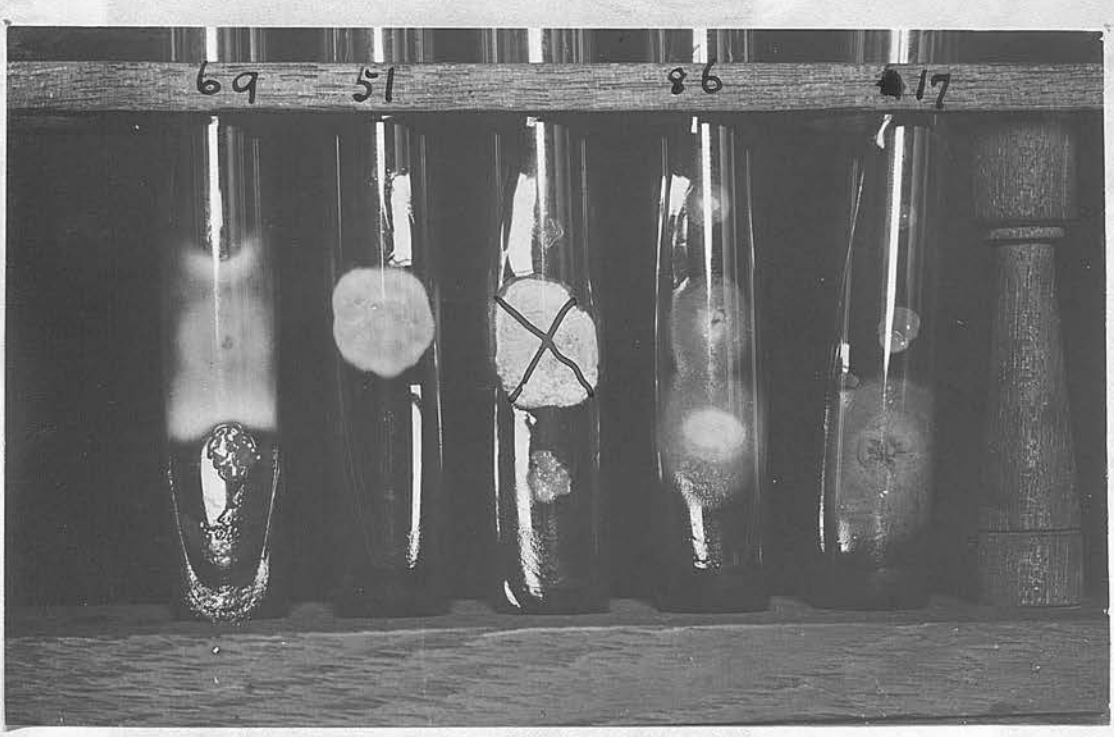
Case 86. Trichophyton purpureum. from hair of face.

Case 51. Trichophyton acuminatum.

Case 76. Trichophyton acuminatum. Young culture.

Case 79. Trichophyton Gypseum interdigitale? pleomorphic.

E.



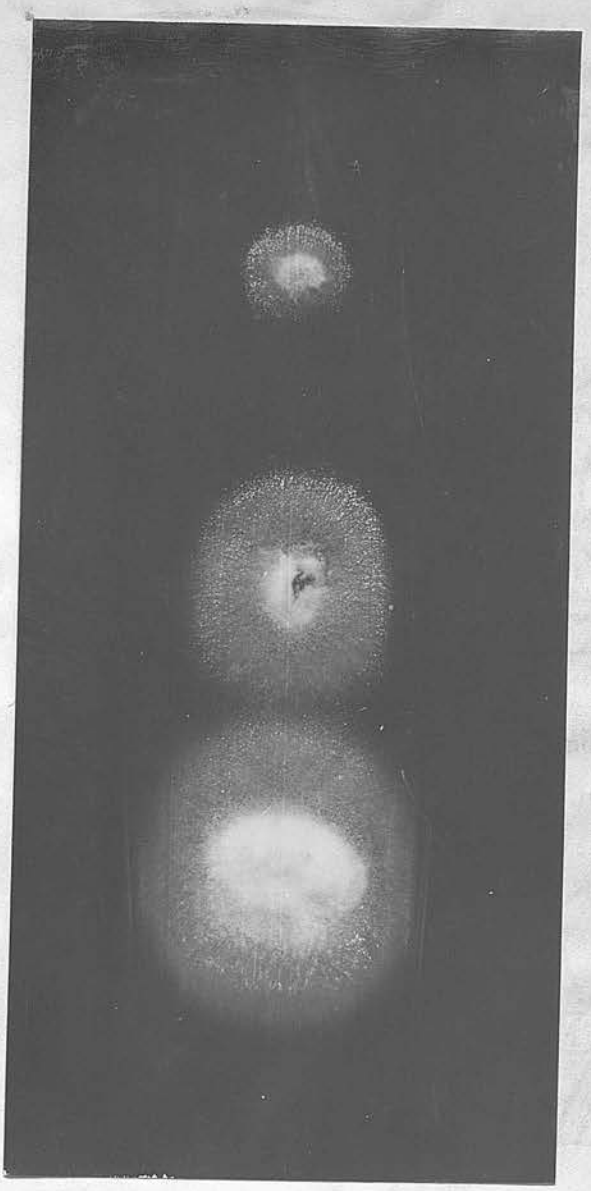
Case 69. microsporon Audouini, from wrist.

" 51 Trichophyton acuminatum.

" 86 " pur purcum from hair of face.

" 17 Epidermophyton inguinale.

F.



Case 86.

Trichophyton purpureum (Bang)

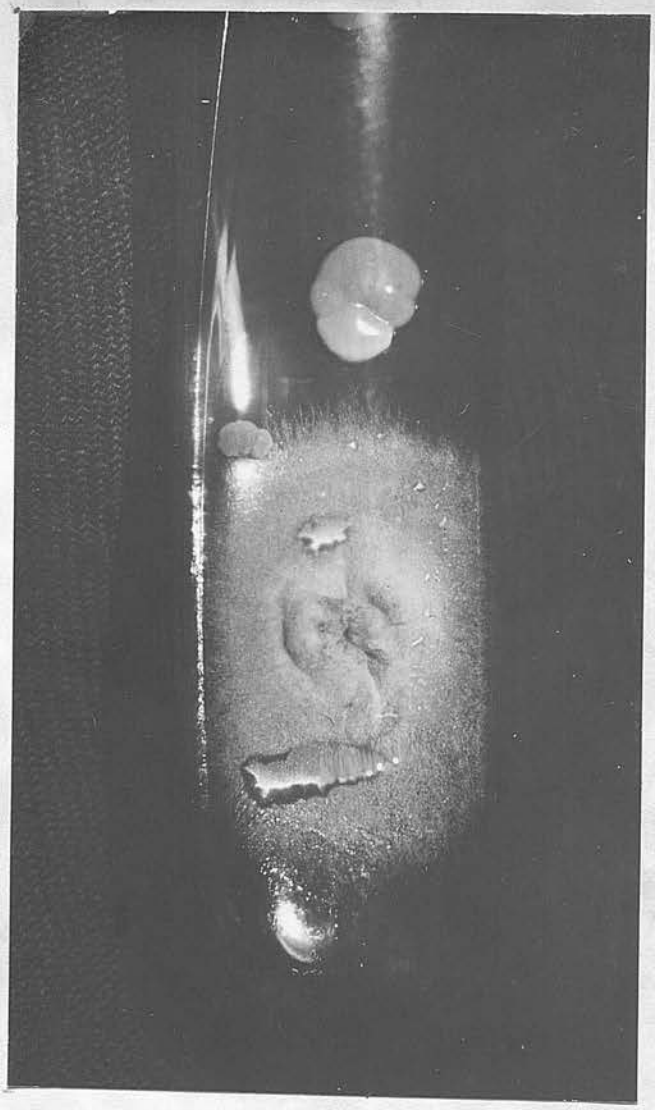
From hair of face.
The purple colour had not yet developed.

G.

Case 58.

Trichophyton acuminatum.

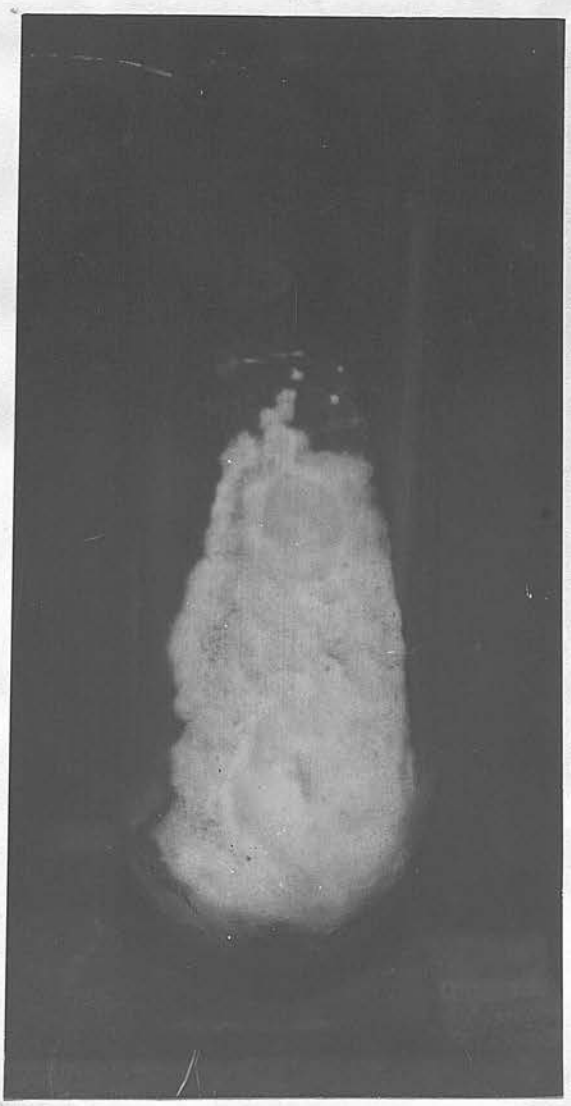
H.



Case 17.

Epidermophyton
Inguinale.

I.



Case 32.

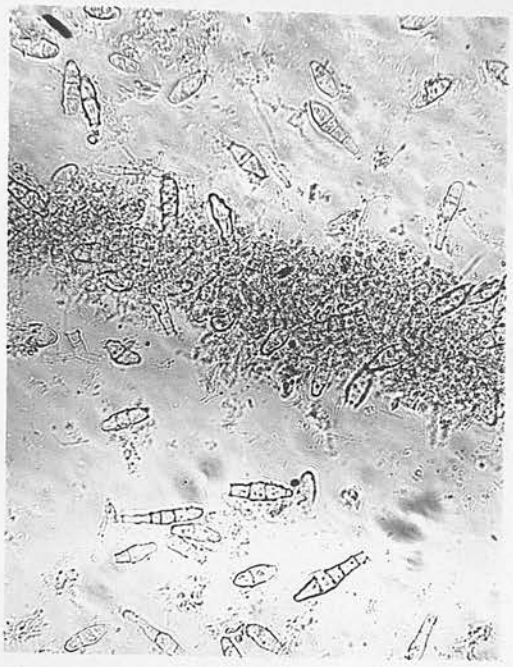
Trichophyton gypseum
Interdigitale?

Pure white growth
on potato.

Micro photographs

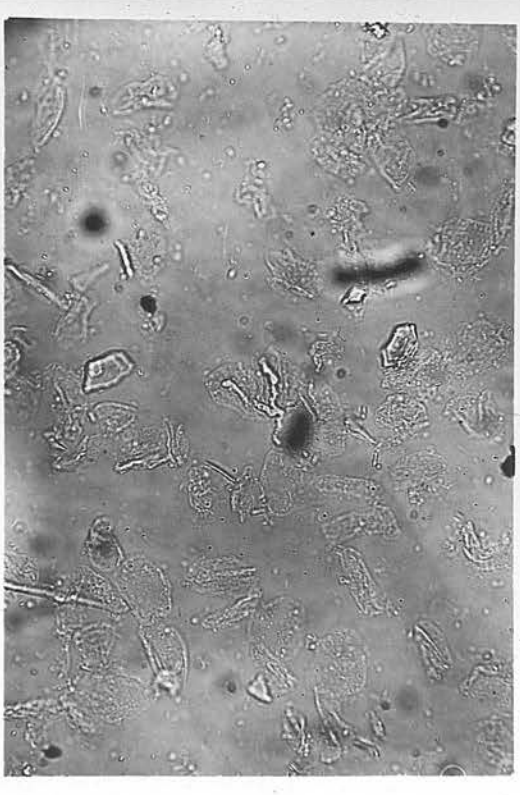
250 magnifications.

1.



Case 9. Epidermophyton inguinale. Typical but degenerated fusearse in old culture.

2.



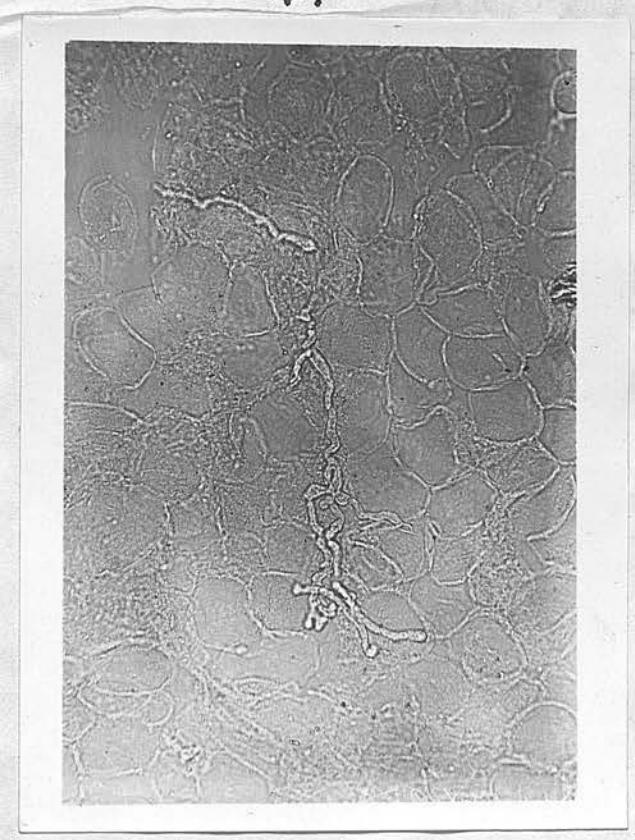
Mycelium in scales in same case.

The preperations from which these microphotos were taken had all been kept for some time.

3.

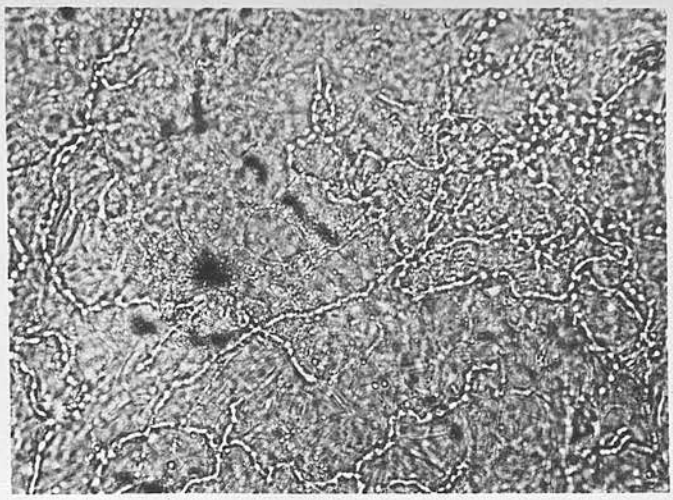
Case 89. Epidermophyton inguinale mycelium from between toes. Clubbed and degenerate looking.

4.



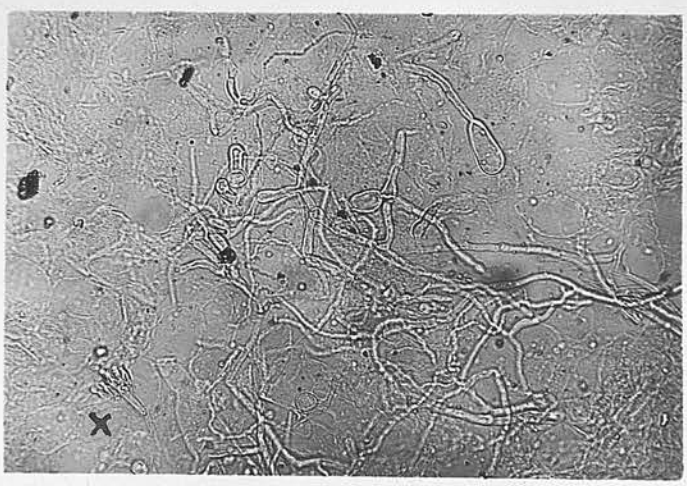
Case 14. Epidermophyton inguinale. Degenerate looking from toe nail.

5.



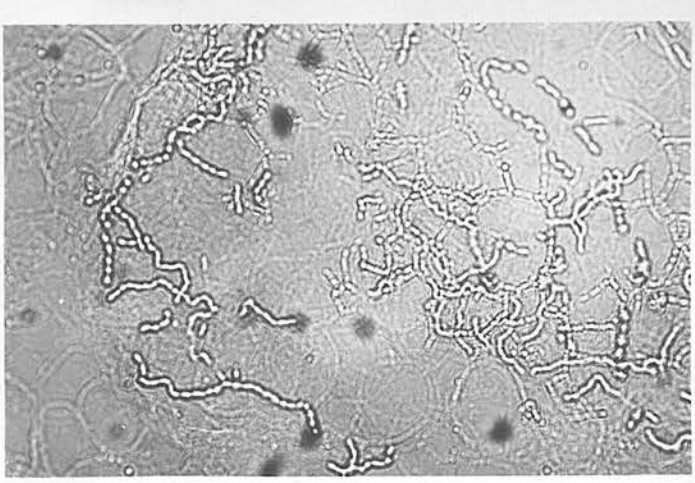
Case 86. Trichophyton purpureum from scales between toes.

6.



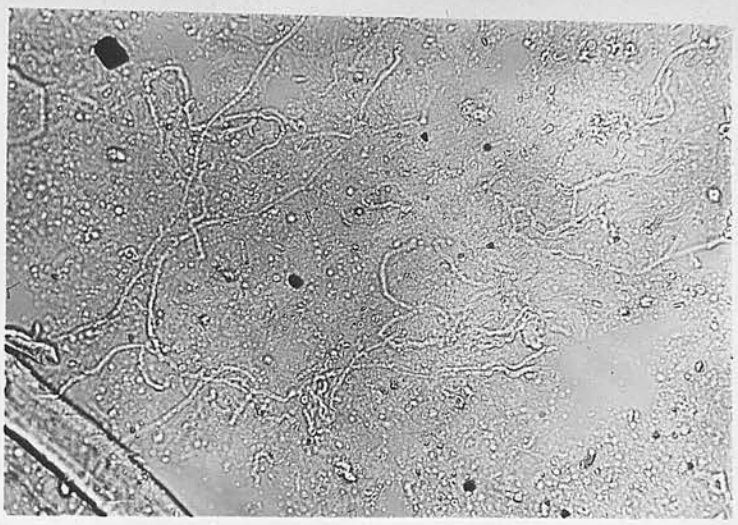
Case 77. Penicillium glaucum. Mycelium from vesicles on hand.
X Spore bearing organ typical of the Penicillium group.

7.



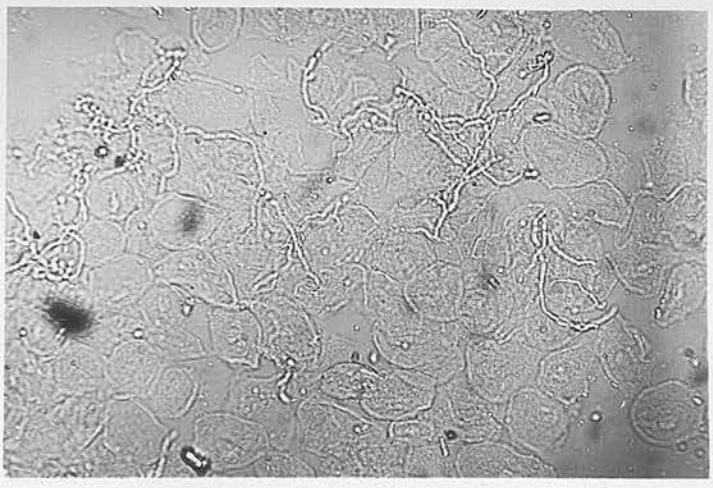
Case 32. Trichophyton gypseum interdigitale?
Typical headed mycelium of trichophytons.

8.



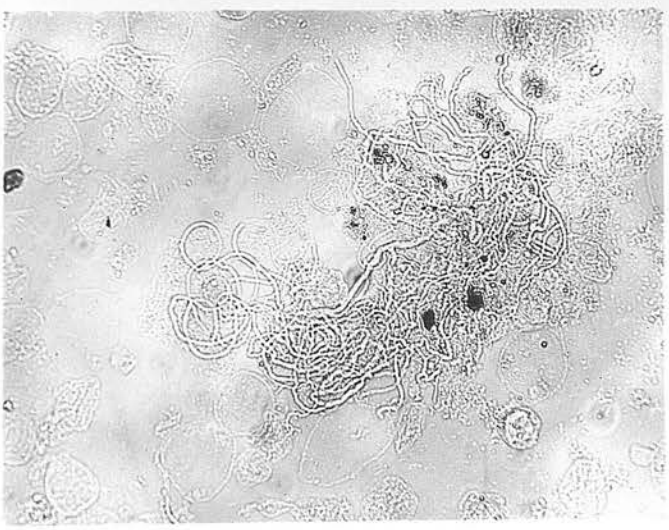
Case 76. Trichophyton acuminatum from back of hand.

9.



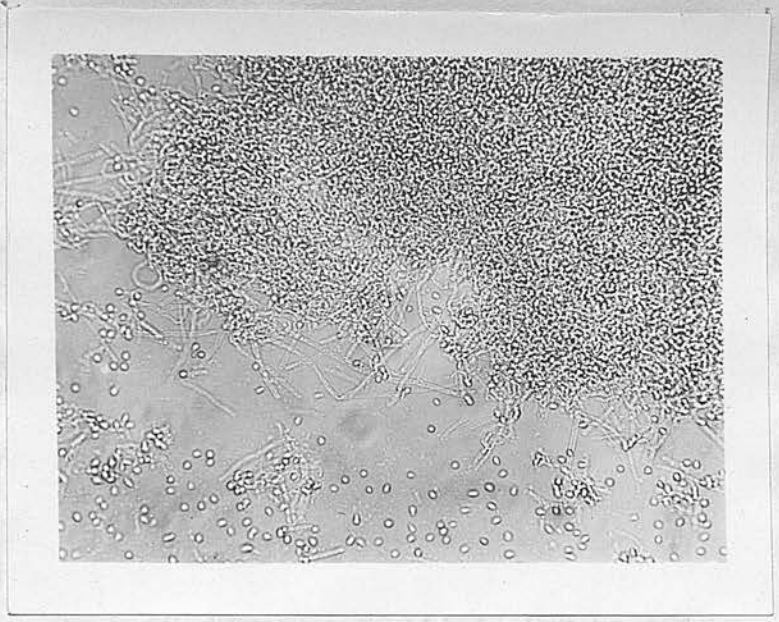
Case 92. Sporio interdigitalis Blastomycetica. Yeast mycelium and a few spores from interdigital space. The preperation was too old to show the grouped spores on the mycelium.

10.



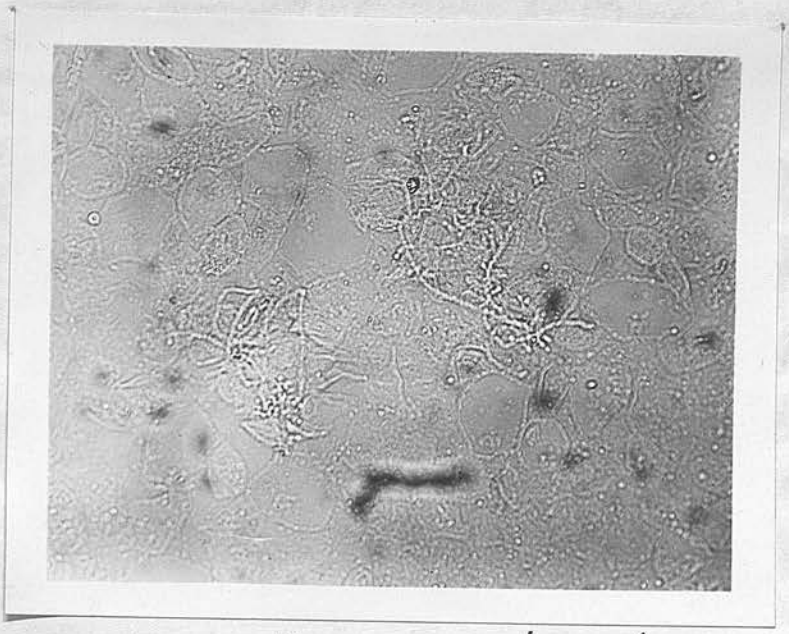
Case 90. Penicillium glaucum. from vesicles + bullae at base of fingers. This photograph does not show the typical penicillium finger like sporangia.

11.



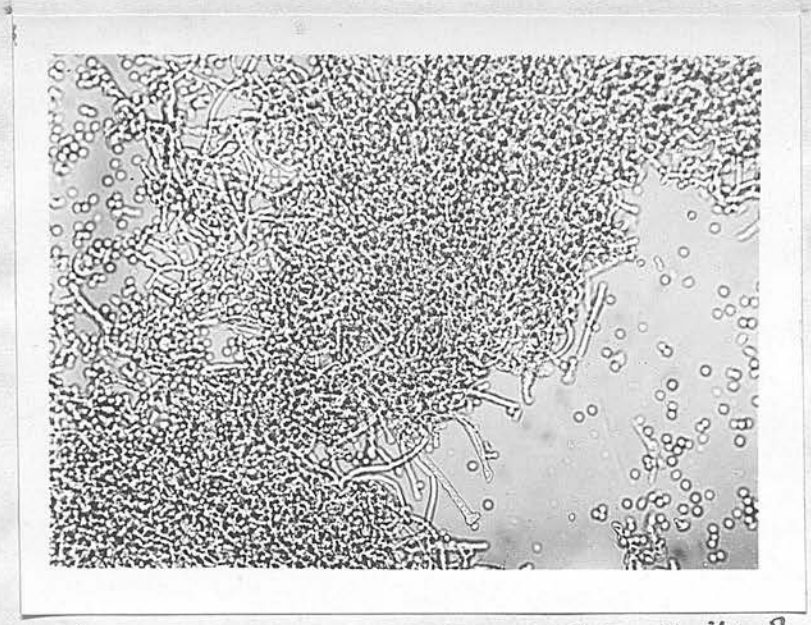
Case 79. Trichophyton gypseum interdigitale?
Culture. No spirals shown.
Compare photo 13.

12.



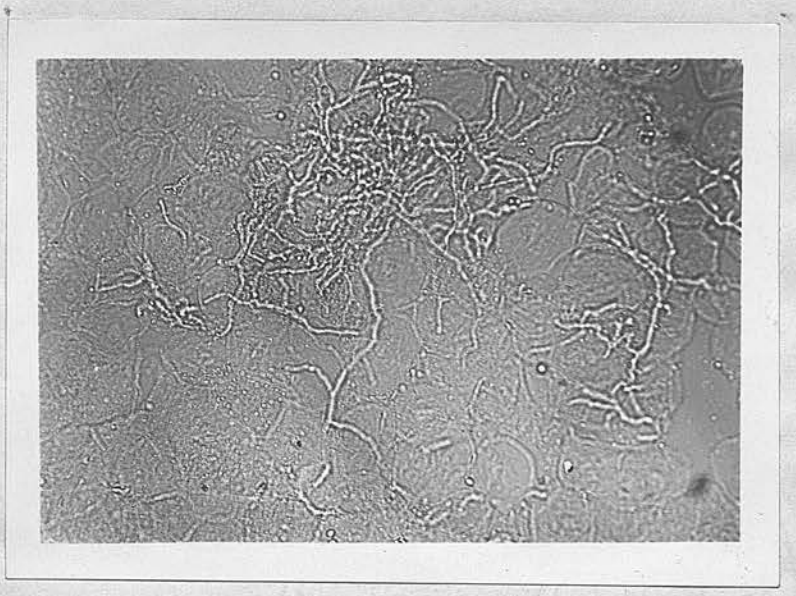
Yeast mycelium and a few spores from an intertrigo in gluteal cleft extending round to either side of scrotum. Yeasts were obtained in practically pure culture.

13.



Case 13. Trichophyton gypseum interdigitale?
Culture. No spirals shown.
Compare photo 11.

14.



Case 79. Trichophyton gypseum interdigitale?
from between toes.